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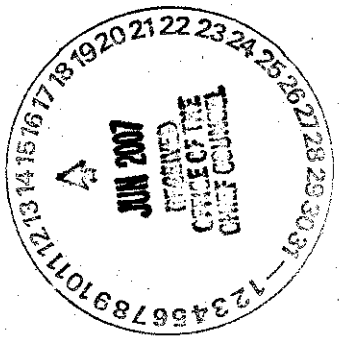

STATE WATER RESOURCES CONTROL BOARD

OF THE STATE OF CALIFORNIA

In the Matter of the Petition of CHEVRON PRODUCTS COMPANY, CONOCOPHILLIPS COMPANY, EXXONMOBIL OIL CORPORATION, BP WEST COAST PRODUCTS, LLC, and WESTERN STATES PETROLEUM ASSOCIATION Request for Technical Reports, California Regional Water Quality Control Board, Los Angeles Region California Water Code § 13267	No. VERIFIED PETITION FOR REVIEW AND REQUEST FOR HEARING

Chevron Products Company ("Chevron"), ConocoPhillips Company ("ConocoPhillips"), ExxonMobil Oil Corporation ("ExxonMobil"), and BP West Coast Products, LLC (collectively "Refinery Petitioners"), and the Western States Petroleum Association ("WSPA") (together with Refinery Petitioners, "Petitioners") hereby timely file this Verified Petition for Review and Request for Hearing.

1. Petitioners' mailing addresses are as follows:

Petitioner	*Address*
Chevron	324 W. El Segundo Blvd. El Segundo, CA 90245
ConocoPhillips	1520 E. Sepulveda Blvd. Carson, CA 90745
ConocoPhillips	150 Pier A Street Wilmington, CA 90744
ExxonMobil Oil	3700 West 190th Street Torrance, CA 90509
BP	2350 E. 223rd Street Carson, CA 90810
WSPA	1415 L Street Sacramento, CA 95814-3801

Refinery Petitioners own and operate petroleum refineries and related marine terminal facilities in the Los Angeles metropolitan area. WSPA is a trade association that represents companies engaged in the exploration and production, refining, marketing and transportation of crude oil and refined products throughout the western United States. Each of the Refinery Petitioners is an active member of WSPA, and works collaboratively with other member companies, through WSPA, to address common issues of concern to the industry. On behalf of its members, WSPA has been an active participant in the Los Angeles Regional Water Quality Control Board's ("Water Board") development of Total Maximum Daily Loads ("TMDLs") for water bodies in the Los Angeles region.

2. Petitioners seek review of a Requirement Under California Water Code Section 13267 for Submittal of Technical Reports on the Fate and Transport of Metals Emitted From [their respective facilities], issued by the Interim Executive Officer of the Water Board on May 15, 2007 ("13267 Requirement Letter"). Copies of the Requirement Letters issued to the Refinery Petitioners are attached as Exhibits 1-5. Petitioners understand that approximately 25 other industrial facilities — out of the literally thousands of stationary sources in the Basin — received comparable directives from the Water Board. The 13267 Requirement Letters require Refinery Petitioners to provide estimates of the

total mass of certain metals that are ***emitted to the atmosphere,*** along with a discussion of the estimation methodology, uncertainties and assumption used in the total mass calculation. In addition, Refinery Petitioners are required to discuss the fate and transport of these metals, *i.e.*, how much is discharged via direct or indirect deposition to specified water bodies or to any other watersheds in the Los Angeles region. The Water Board states that this information is required to assess the significance of atmospheric deposition as a source of metals discharged to water bodies which are listed under section 303(d) of the federal Clean Water Act ("CWA") and that are the subject of upcoming TMDLs.[1]

3. This Petition is filed pursuant to section 13320 of the Water Code, which authorizes any aggrieved person to petition the State Water Resources Control Board ("State Board") to review any action (or failure to act) by a regional board. *See* Water Code, § 13223 (actions of the regional board shall include actions by its executive officer pursuant to powers and duties delegated to him by the regional board).

4. Petitioners challenge the Water Board's issuance of the 13267 Requirement Letters on the grounds that such action is outside the scope of the Water Board's legal authority under Water Code section 13267 and thus in violation of law. Further, the action of the Water Board is arbitrary and capricious in that it was taken precipitately, without due consideration of the specific manner in which the requested fate and transport studies were to be conducted, the amount and quality (statistical validity) of the data that may be produced from the studies, or whether the results of independently designed and conducted studies by relatively few emitting facilities could even be used to draw useful or scientifically reliable conclusions. Most importantly, the Water Board's action ignores the

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[1] Petitioners note that there is not a perfect correlation between the water bodies identified in the 13267 Requirement Letters, the pollutants that are included on the State's 2006 303(d) list for those water bodies, and the pollutants for which information is sought in the Requirement Letters. For example, Santa Monica Bay is ***not*** listed as impaired for mercury or zinc, and presumably TMDLs will not be established for either of these pollutants. Nevertheless, the 13267 Requirement Letter issued to Chevron (which discharges to Santa Monica Bay under an NPDES permit), requires submittal of information on emissions of mercury and zinc. The Water Board's purpose in asking for this information is thus unclear.

fact that road dust associated with vehicular travel has already been demonstrated to be the primary source of aerial deposition of metals to waters in the region.

5. Petitioners are aggrieved because they are being directed to take actions they believe to be unauthorized and of no scientific merit. The Water Board's actions are taken without regard to the authority and function of the South Coast Air Quality Management District ("SCAQMD"), and threaten to interfere with the extensive regulatory framework that already exists around the estimation and control of emissions to the atmosphere.

6. Petitioners request that the State Board grant the relief requested in this Petition, as set forth in the Request for Relief.

7. Petitioners' statement of points and authorities in support of the issues raised by this Petition commences below.

8. A copy of this Petition is being sent by first-class mail to the Water Board, on June 14, 2007, to the attention of Ms. Deborah J. Smith, Interim Executive Officer.

9. The 13267 Requirement Letters were issued to Petitioners without any formal procedure or notice and opportunity to comment on the record. *See* 23 Cal. Code Regs., §§ 2050(a)(9), 2050(c).

10. Petitioners request a hearing to address the contentions in the Statement of Points and Authorities and reserve the right to present additional evidence. *See* 23 Cal. Code Regs., § 2050.6.

STATEMENT OF POINTS AND AUTHORITIES

I. INTRODUCTION.

A. Background.

This Petition arises out of the Water Board's actions taken in direct response to a "petition" filed by the Natural Resources Defense Council ("NRDC") on March 12, 2007, demanding that requests for technical reports be issued to a number of stationary sources in the Los Angeles Basin, including petroleum refineries and related facilities owned and operated by the Refinery Petitioners, that emit various compounds to the air (namely lead, ammonia, copper, sulfates, zinc or mercury). Broadly proclaiming that the regional water quality control boards have the authority under the Porter-Cologne Water Quality Control Act ("Porter-Cologne Act") to investigate "any activity or factor that may affect water quality," and pointing to the Water Board's obligation to develop TMDLs for impaired water bodies in the Los Angeles area, NRDC blithely categorizes these emitting facilities as "dischargers" under the Water Code, and asserts they are subject to the full panoply of regulation under the statute, including the requirement to submit technical reports (Water Code, § 13267), to file Reports of Waste Discharge (Water Code, § 13260) and to obtain Waste Discharge Requirements (Water Code, § 13264) — all in respect of their emissions to the atmosphere.

Fundamental rules of statutory construction and interpretation, and over 50 years of administrative practice and precedent, compel a different result than the one reached by NRDC and by the Water Board in response to NRDC's "petition." Literalism aside, atmospheric emissions are not "discharges of waste" under the Water Code, and the water boards have no authority under the Water Code to regulate them as if they were.

Stationary sources are non-mobile sources of gaseous emissions to the atmosphere. The regulatory and permitting schemes that have been established by the U. S. Environmental Protection Agency ("EPA") and SCAQMD over a period of many years are extremely complex and establish an interwoven set of pervasive, stringent controls on virtually all but the smallest sources of atmospheric emissions. SCAQMD employs

hundreds of experienced air quality engineers and scientists who implement and oversee the air quality program in the South Coast and who are tasked to ensure that these regulations, and the permits that implement them, are based on sound science and good engineering practice. While Petitioners do not dispute that aerial deposition can be a source of pollutant loading to water bodies,[2] the Water Board's ad hoc foray into the world of air pollution control is without legal foundation and, if allowed to proceed along the path advocated by NRDC, would interfere significantly with the SCAQMD's regulatory function. While Water Board staff personnel are experienced in the area of water quality regulation, they have no experience in the vastly different field of air pollution control, as evidenced by the misguided demand for technical reports issued on May 15.

B. The Bay Area Air Deposition Study.

Both the Water Board and the NRDC petition point to the 13267 letter issued to the Bay Area petroleum refineries in February 2005, relating to mercury emissions, as precedent for the 13267 Requirement Letters being challenged herein. This reliance is misplaced, and more recent actions of the San Francisco Water Board under Water Code section 13267 are the subject of a pending Petition for Review and Request for Stay filed with the State Board on June 6, 2007. *See* SWRCB/OCC File A-1851 (hereafter "Bay Area Petition").

The February 2005 letter issued by the San Francisco Water Board requires the Bay Area refineries to conduct a study of the fate of mercury in air emissions from the refineries. This request was a negotiated compromise between San Francisco Water Board staff and the refiners, who disagreed over the proper interpretation of language in the

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[2] "Atmospheric deposition" is generally described as the process whereby pollutants are transferred from the air to the earth's surface. http://www.epa.gov/glindicators/air/airb.html (last visited June 12, 2007). The terms "air deposition" and "aerial deposition" are also used to describe "atmospheric deposition." "Atmospheric deposition comes from *emissions* of air pollutants from natural and human-made (anthropogenic) sources." *See Frequently Asked Questions About Atmospheric Deposition: A Handbook for Watershed Managers*, U.S. EPA (September 2001), at 5 (emphasis added). However, none of these terms is defined in the Porter-Cologne Act, the CWA or any corresponding regulations.

Mercury TMDL for San Francisco Bay that requires the Bay Area refiners to study "the environmental fate of mercury in crude oil" as a TMDL adaptive implementation measure. Staff interpreted this language as authorizing them to require the refiners to measure the amount of mercury in their incoming crudes and to conduct a refinery-wide mercury mass balance analysis. The Bay Area refiners disputed this interpretation, as well as the Water Board's assertion of authority to investigate or regulate air emissions in the first instance. The Bay Area refiners ultimately agreed to conduct the air deposition study on a voluntary basis, effectively reaching a resolution of the dispute and avoiding a formal confrontation with staff. *See* Bay Area Petition, pp. 7-8. At no time did the Bay Area refineries concede that the Water Board had authority to require the air deposition study, nor has the Water Board's authority in this regard ever been adjudicated.

On May 7, 2007, before the air deposition study could even be completed, the San Francisco Water Board issued an updated 13267 letter requesting information on the mercury content of crude oil processed by the refineries and requiring a refinery mercury mass balance analysis. The Bay Area refiners are seeking review of this action, including those aspects of the request which expanded the scope of the air deposition study beyond what was agreed upon in 2005. As a reflection of their good faith, and despite the fact that the request for a mass balance study violates the compromise reached in 2005, the Bay Area refineries are committed to completing the air deposition study they agreed to undertake in 2005, and are moving forward with that work, under a reservation of rights, pending the State Board's review of the contested aspects of the new 13267 demand. Contrary to the assertions of the Water Board and NRDC, this voluntary commitment — reached as part of a compromise with the San Francisco Water Board — cannot be considered "precedent" that is in any way binding on sources in the Los Angeles region.

C. <u>The Scope of the Water Board's Authority Under Section 13267 Raises Significant Issues Appropriate for Review by the State Board.</u>

For the reasons outlined above, and in consideration of the legal principles discussed below, the scope of the Water Board's authority under Water Code section 13267

raises significant issues that are appropriate for review by the State Board. Unless this issue is resolved now, Refinery Petitioners — like the refineries in the Bay Area — are likely to be subject to increasingly far-reaching and technically unwarranted demands for information relating to air emissions, all based on the Water Board's untested assertion of authority under section 13267. In furtherance of the Water Board's basic authority under the Porter-Cologne Act, "[a] regional board, in establishing or reviewing any water quality control plan or waste discharge requirements, or in connection with any action relating to any plan or requirement ***authorized by this division***, may investigate the quality of any waters of the state within its region." Water Code, § 13267(a) (emphasis added). In conducting such an investigation, the regional board may require technical or monitoring program reports from

> any person who has ***discharged, discharges***, or is suspected of ***having discharged or discharging***, or who ***proposes to discharge*** waste within its region, or any citizen or domiciliary, or political agency or entity of this state who has *discharged*, *discharges*, or is *suspected of having discharged or discharging*, or who *proposes to discharge*, waste outside of its region that could affect the quality of waters within its region . . . .

Id. at §13267(b)(1) (emphasis added).

Based on the plain language of the statute, the authority of regional boards to conduct investigations pursuant to section 13267 is limited to activities which they are otherwise authorized to take under the statute, *i.e.*, those relating to "discharges" or "proposed discharges." The question that is squarely presented is whether the term "discharger" may reasonably be construed, within the context of the Porter-Cologne Act, to include a facility whose purported "discharges" are not to water bodies, but instead are gaseous emissions to the atmosphere. Petitioners respectfully submit that the answer to this question is "no." As discussed below, there is no support for such authority in the Water Code itself, or in any expressions of legislative intent during the enactment of the Porter-Cologne Act, or in relevant case law or State Board decisions. Moreover, the requirement that water boards develop TMDLs under section 303(d) of the Clean Water Act, 33 U.S.C.

§ 1313(d), does not afford the boards the authority to regulate air emissions or to require companies to investigate air emissions as an antecedent to such regulation. The 13267 Requirement Letters issued by the Water Board attempt to regulate activities beyond the scope of "discharges," and the Regional Board has thereby exceeded its statutory authority under the Water Code.

II. THE WATER BOARD HAS NO AUTHORITY UNDER THE PORTER-COLOGNE ACT TO REQUIRE STATIONARY SOURCES TO INVESTIGATE AIR EMISSIONS.

A. Refinery Petitioners' Status As NPDES Dischargers Does Not Authorize Issuance of the 13267 Requirement Letters.

As a preliminary matter, Refinery Petitioners' status as "dischargers" under the National Pollutant Discharge Elimination System ("NPDES") permit program is not relevant to whether the Water Board has authority to issue the contested 13267 Requirement Letters to them. The NPDES permitting program is a vehicle by which the Water Board regulates "point source discharges to waters of the United States," in accordance with specific criteria and guidance set forth in the Clean Water Act and its implementing regulations. 33 U.S.C. § 1342. The NPDES program does not broaden the Water Board's authority under other provisions of state law (such as Water Code section 13267), nor does it provide an independent source of authority that overrides express or implied limitations on the water boards' authority under state law. More specifically, the fact that a facility may hold an NPDES permit does not give the Water Board broader investigative or regulatory authority over that facility than it would otherwise have.[3]

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[3] It is worth noting that, while the Refinery Petitioners have NPDES permits, most of them discharge to Publicly Owned Treatment Works ("POTWs"), in accordance with the terms and conditions of local industrial discharge permits, and as such are not routinely regulated by the Water Board. With one exception, the refineries' NPDES permits are used primarily for storm water discharges and then only on an infrequent basis, given the low precipitation rates in the basin. For example, one of the refineries has not discharged under its NPDES permit since 2001. Another refinery has discharged on only two occasions during the past seven years.

B. The Water Board's Authority is Defined and Limited by the Water Code.

The authority of an administrative agency is derived entirely from its enabling statute, and any agency action conducted outside the scope of such statutory authority is void. *Ass'n for Retarded Citizens v. Dep't of Developmental Serv.*, 38 Cal.3d 384, 391 (1985) ("Administrative action that is not authorized by, or is inconsistent with, acts of the Legislature is void."); *City of South Pasadena v. Slater*, 56 F. Supp 2d 1106, 1144 (C.D. Cal. 1999) ("An administrative agency's failure to comply with the law invokes a public interest of the highest order: the interest in having government officials act in accordance with the law"). In this case, the Water Board is attempting to order private parties to investigate sources of air emissions, claiming such authority can be found in section 13267 of the Water Code. As noted above, section 13267 applies to those who "discharge" or "propose to discharge" "waste" to waters of the State, and those terms circumscribe the scope of the Water Board's authority.[4] Emissions to the atmosphere are not "discharges" under the plain meaning of the word, and any interpretation that strains to reach a contrary conclusion ignores the long-settled rules of statutory construction as set forth below.

C. Principles of Statutory Construction Require Consistent Interpretation of the Law, in Accordance with Legislative Intent.

In order for the Water Board to lawfully investigate air emissions pursuant to section 13267, the term "discharge," as used in that section and elsewhere in the Water Code, would have to be defined to include emissions that cause atmospheric deposition to waters of the state. Despite its ubiquitous usage throughout the code, the term "discharge" is not defined in the statute except for purposes of Chapter 5.5 (Water Code, §§ 13370-13389) where it has the same meaning as "point source" under the federal CWA. Water

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[4] Other statutory provisions that grant investigatory authority to the water boards are similarly limited to "dischargers." *See* Water Code, § 13383(a) (The state board or a regional board may establish inspection requirements, "as authorized by Section 13160, 13376, or 13377 or by subdivisions (b) and (c) of this section, for any person who *discharges*, or *proposes to discharge*, to navigable waters . . .").

Code, § 13373.[5] Where the legislature has not defined a word used in a statute (as is the case here), the ordinary rules of statutory construction apply, as discussed below.

In examining any statute, the State Board (as would a Court) must be guided by the well-established principle that its function (in this circumstance) is to "ascertain the intent of the lawmaker so as to effectuate the purpose of the law." *People v. Pieters*, 52 Cal. 3d 894, 898 (Cal. 1991); *Mir v. Charter Suburban Hospital*, 27 Cal. App. 4th 1471, 1482 (Cal. Ct. App. 1994). The State Board must determine such intent by first focusing on the words used by the legislature, giving them their ordinary meaning. *Mercer v. Department of Motor Vehicles*, 53 Cal. 3d 753, 763 (Cal. 1991). This is because "it is the language of the statute itself that has successfully braved the legislative gauntlet." *Halbert's Lumber, Inc. v. Lucky Stores, Inc.*, 6 Cal. App. 4th 1233, 1238 (Cal. Ct. App. 1992). In ascertaining the legislative purpose of the statute, the State Board must also consider "its objective, the evils which it is designed to prevent, ***the character and context of the legislation in which the particular words appear***, the public policy enunciated or vindicated, the social history which attends it, ***and the effect of the particular language on the entire statutory scheme***." *Santa Barbara County Taxpayers Assn. v. County of Santa Barbara*, 194 Cal. App. 3d 674, 680 (Cal. Ct. App. 1987) (emphasis added).

The Water Code was designed to regulate activities that cause releases or drainages of waste that flow into or enter waters of the state. *See generally* "*Recommended Changes in Water Quality Control, Final Report of the Study Panel to the California State Water Resources Control Board*" (March 1969) (the "Study Panel Report") (proposing extensive changes to California water quality control laws). Sources of such "releases" and "drainages of waste" include point sources such as manufacturing and industrial facilities and POTWs, and non-point sources such as stormwater drainage and agricultural runoff. Waste from these sources can enter waterbodies directly by flowing into surface waters or infiltrating to groundwater, or indirectly by the application of waste to land that eventually

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[5] Plainly, emissions to the atmosphere are not "point sources" under the CWA.

enters waters of the state through storm water runoff or migration of leachate.[6] Although few California courts have addressed the scope of "discharge" under the Water Code, the *activities* at issue in cases interpreting the term "waste" under the statute are particularly instructive as to what constitutes a "discharge." *See Sutter County v. Nicols* (1908) 152 Cal. 688, 695-96 (the discharge of tailings and debris from a mine into rivers, constitutes a nuisance unless authorized by law); *People v. New Penn Mines, Inc.*, 212 Cal. App. 2d 667, 673 (1963) (mine wastes, such as ore tailings and refinery run-off, are "industrial waste" within the Water Code); *Lake Madrone Water Dist. v. State Water Resources Control Bd.*, 209 Cal.App.3d 163, 174 (1989) (concentrated sediment flushed from dam used to create recreational lake which clogged downstream creek constituted a "discharge of waste" for purposes of Water Code).

Under these basic rules, air "emissions" cannot reasonably be considered "discharges" under the Water Code. If for no other reason, this would extend the regulatory reach of the water boards (and the State Board) to virtually all industrial facilities in the state, given the thousands of water bodies in California. And, if "emissions" are "discharges," what would preclude vehicular exhaust from being classified as a "discharge"? Logically, if the Water Board believes it has authority to regulate sources of aerial deposition that have the potential to adversely affect water quality, then all motor vehicles — from huge fleets of diesel trucks to the private family car — are subject to the jurisdiction of the board. This is an absurd result that reveals the patent flaw in the Water Board's position.

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[6] "Waste" is defined under the Porter-Cologne Act to include "sewage and any and all other waste substances, liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing, or processing operation, including waste placed within containers of whatever nature prior to, and for purposes of, disposal. Water Code, § 13050(d). Petitioners maintain that the reference to "gaseous" wastes in this section does not constitute a sufficient legal basis for issuance of the 13267 Requirement Letters. While the categories of "wastes" that are regulated under the Water Code are seemingly all-inclusive, they must in every case be "discharged" into waters of the state in order to fall within the scope of the Water Board's authority.

D. The Attorney General's Opinions on the Meaning of "Discharge" Do Not Support the Water Board's Extension of the Term to Air Emissions.

In the absence of a statutory or regulatory definition of "discharge," the California Attorney General has offered several legal opinions regarding the definition of "discharge." These opinions conclude that a "discharge" involves the addition of waste to waterbodies by either directly flowing into surface waters or groundwaters, or by the application of waste to land that eventually enters waters of the state during stormwater events. The Attorney General addressed this issue in 1956 in response to a request by the State Water Pollution Control Board for an opinion on whether numerous and varied industrial and agricultural activities "constitute a discharge of waste over which a regional water pollution control board has jurisdiction." 27 Op. Atty. Gen. 182 (1956). In concluding that all such activities were "discharges" subject to regional board jurisdiction, the Attorney General explained that:

> the tests which control whether a discharge of waste under the jurisdiction of a regional water pollution control board is occurring are these. First, there must be a present discharge, that is, ***a present flowing or issuing out***, of harmful material from the site of the particular operation into the waters of the State. The operation which produced the harmful material need not, however, be currently conducted. As was pointed out in 26 Ops. Cal. Atty. Gen. 88, it is the ***release or drainage*** of that material ***into*** the waters of the State, and not the production of the material, which constitutes the discharge."

Id. (emphasis added). Factual settings in which the Attorney General has rendered opinions include: (1) *drainage, flow, or seepage* containing debris or earth from logging operations;[7] (2) *drainage, flow or seepage* containing garbage, ashes, mixed refuse, or solid industrial waste from dumps;[8] (3) return *irrigation or drainage water* from agricultural operations;[9]

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[7] 27 Ops. Atty. Gen. 182, 184 (1956).

[8] *Id.*

[9] *Id.*

(4) *run-off* from agricultural fields following routine application of pesticides;[10] (5) changes in the physical or chemical characteristics of receiving waters caused by extraction of minerals from a streambed;[11] and (6) dumping of earth moved from construction operations, or *drainage of wastewater* from construction sites.[12] None of these opinions makes any mention of air emissions associated with these activities. The common thread in all of these decisions is that all of the "waste"-producing activities which resulted in a "discharge" involved discharges to surface or ground waters or application to land — not to the air.

The traditional definition of "discharge," as described above, is supported by the State Board regulations applicable to discharges of hazardous waste to land. *See* 23 Cal. Code Regs. § 2601, *et seq.* Under section 2601, the term "discharger" is defined as "any person who discharges waste which could affect the quality of waters of the state." This same definition appears in the Title 27 regulations applicable to other classes of waste management units. See 27 Cal. Code Regs., § 20164. In the case of Class 1 (hazardous waste) units, the term "discharge" is further defined by reference to the state hazardous waste regulations as "the accidental or intentional *spilling, leaking, pumping, emitting, emptying or dumping* of hazardous waste into or on any land or water." *See* 22 Cal. Code Regs., § 66260.10. "Emitting" in this context does not refer to gaseous emissions to the air. According to the doctrine of *ejusdem generis,* "when a statute contains a list or catalogue of items, a court should determine the meaning of each by reference to the others, giving preference to an interpretation that uniformly treats items similar in nature and scope." *Ornela v. Randolph,* 4 Cal. 4th 1095, 1101 (1993). Air emissions — which involve the release of gas to the atmosphere — are in no way related to "spilling, leaking, emptying or dumping." In fact, uncontained gaseous emissions such as those the Water Board seeks to

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[10] 43 Ops. Atty. Gen. 302, 304 (1964).

[11] 32 Ops. Atty. Gen. 139, 140-41 (1958).

[12] 16 Ops. Atty. Gen. 125, 130-31 (1950).

investigate through the 13267 Requirement Letters are ***not*** subject to regulation under either state or federal hazardous waste laws despite the explicit reference to "emitting" in the definition of "discharge." *In the Matter of: BP Chem. Am. Inc., Lima, Ohio*, 1991 WL 208971 (E.P.A.); *see* 54 Fed. Reg. 50973 (December 11, 1989) ("EPA now believes our authority to identify or list a waste as hazardous under RCRA is limited to containerized or condensed gases (*i.e.*, section 1004(27) of RCRA excludes all other gases from the definition of solid wastes and thus cannot be considered hazardous wastes)"); *see also* Health & Saf. Code, §§ 25110.11 and 25201.12 (excluding regulation of exhaust from the scope of the Hazardous Waste Control Law). Thus, it is clear for purposes of discharges of hazardous waste to land, that "discharges" are limited to the seepage or flow of waste to surface water, groundwater or to land. The same logically applies to discharges of other types of waste.

E. The Legislative History Does Not Support Inclusion of Air Emissions as Discharges under the Porter-Cologne Act.

It is a general rule of statutory construction that courts must give a statutory provision "a reasonable and common sense interpretation consistent with the apparent purpose and intention of the lawmakers . . . which upon application will result in wise policy rather than mischief or absurdity." *DeYoung v. San Diego*, 147 Cal. App. 3d 11, 18 (Cal. Ct. App. 1983), *overruled on other grounds in Yamaha Corp. of America v. State Bd. of Equalization,* 19 Cal. 4th 1, 15 (Cal. Cal. Ct. App. 1998). *See also Gustafson v. Alloyd Co.*, Inc., 513 U.S. 561, 575 (1995) (concluding that the phrase "any note" should not be interpreted to mean literally "any note," but must be understood against the background of what Congress was attempting to accomplish in enacting the Securities Acts) ("We rely upon [the doctrine of *noscitur a sociis*] to avoid ascribing to one word a meaning so broad that it is inconsistent with its accompanying words, thus giving 'unintended breadth to the Acts of Congress'"). Here, the Water Board essentially asserts that it has authority to regulate *any* act that may have an affect on water quality. This is an untenable position, contrary to legislative intent. *See Times Mirror Co. v. Superior Court*, 53 Cal. 3d 1325,

1334 n.7 (1991) (where a statute is *theoretically* capable of more than one construction, the Court must choose that which most comports with the intent of the legislature).

The Porter-Cologne Act became effective on January 1, 1970, replacing the Dickey Act as the primary water quality control law in California.[13] The Porter-Cologne Act was the first complete revision to California's water pollution control laws in two decades and was adopted, in part, to enable the State and regional water boards to better carry out the State's water quality objectives.[14] Prior to the adoption of the statute, the State Board commissioned a review of the existing water quality legislation. The Study Panel Report was submitted to the State Legislature, and "legislation in substantial conformance with the changes recommended by the Study Panel was signed by the Governor."[15] Although the Study Panel Report does not address the meaning of "discharge" under the Water Code, it provides insight into the types of activities that were considered sources of water pollution and thereby subject to regulation under the Act.

Significantly, the Study Panel was particularly concerned about the increase in *uses of water* that generate waste discharges:

> During the last 20 years, there has been created a great deal more waste to be discharged – domestic and industrial waste, drainage from farmlands – all the side effects of more people, more prosperity, and more products. As a result, more than 80 percent of the water used nationwide by man has been previously used.

Study Panel Report, at 2. One of the primary concerns of the Study Panel was thus the need for a waste discharge permit program to control wastes entering waters of the state. The Study Panel recommended that point source discharges be controlled by establishing waste discharge requirements. *Id.* at 15. The Study Panel specifically recognized the

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[13] Ronald B. Robie, *Water Pollution, An Affirmative Response by the State Legislature*, 1 PAC. L.J. 2 (1970).

[14] *Id.*

[15] Robie, *supra* note 13, at 4. The Study Panel Report includes "extensive notes intended to assist in determining legislative intent." *Id.* n.10.

regulatory challenges that come from non-point sources, noting "there are many uncontrollable pollutants which enter the waters of the state, such as runoff from urban and agricultural lands, for which provision[s] must be made." *Id.* However, even though the Study Panel recognized that many different sources affect water quality, air emissions were never considered as a source of water quality impairment through air deposition.

As noted above, the Attorney General squarely and frequently addressed the meaning of the word "discharge" under the Dickey Act. Accordingly, it comes as no surprise that the Legislature, in enacting the Porter-Cologne Act, did not feel obliged to include a definition of "discharge" in the new legislation. Since the Attorney General opinions pre-dated the Porter-Cologne Act (which lacks a definition of "discharge"), it can be inferred that the Legislature considered the meaning of "discharge" to be well understood and not different from that articulated by the Attorney General opinions. Moreover, it is evident that the scope of other definitions used in the Dickey Act remained unaltered following the Porter-Cologne Act. For example, under the Porter-Cologne Act, "the word 'waste' is intended to be as all inclusive as the Dickey Act definitions it replaces and, therefore, the opinions of the attorney general relating to discharges of 'sewage,' 'other waste' and 'industrial waste' are still applicable.'" Robie, *supra* note 13, at 8. The same is true of the meaning of "discharge," which the Legislature determined was unnecessary to separately define.

F. The Water Board's Implied Authority to Regulate Does Not Extend to Air Emissions.

Obviously, if the Legislature had intended the water boards to have authority to investigate air emissions, it could have so stated in the statute. By confining itself to the same terminology used elsewhere in the statute, it must be concluded that the Legislature intended section 13267 to be limited to waterborne discharges. Thus, even if the information requested by the Water Board in the 13267 Requirement Letters would be helpful to determining or better understanding sources of pollution "affecting" water quality in the region, the Legislature has not authorized the Water Board to exert authority

to require private parties to develop this information. Nor can this authority be implied from the Water Board's broad mandate regarding "water quality control" and the necessary authority it carries to regulate activities which "may affect the quality of the waters of the State." Water Code, § 13000. As the court in *Addison* stated,

> the doctrine of implied powers is not without limitations. It cannot be invoked where the grant of express powers clearly excludes the exercise of others, or where the claimed power is incompatible with, ***or outside the scope of, the express power. For a power to be justified under the doctrine, it must be essential to the declared objects and purposes of the enabling act -- not simply convenient, but indispensable. Any reasonable doubt concerning the existence of the power is to be resolved against the agency.***

Addison v. Dept. of Motor Vehicles 69 Cal. App. 3d 486, 498 (Cal. App. Ct. 1977) (emphasis added). While Water Board staff may have an interest in studying airborne emissions and their connection to water quality impairment, that investigation cannot be compelled under the guise that air emissions constitute "discharges" under the Water Code. Nor may this investigation be imposed on the refineries because it is convenient to do so. To the extent there is any doubt surrounding these issues, it must be resolved against the agency.

Similar limitations exist on administrative agencies' subpoena power, a type of investigatory authority not unlike that exercised here. Subpoenas issued by administrative agencies will not be enforced where the investigation is outside the authority of the agency, the demand is too indefinite, or the information sought is not reasonably relevant to the investigation. *Peters v. United States*, 853 F.2d 692, 699 (9th Cir. 1988). Such requirements are based on the fact that the "authority of an administrative agency to issue subpoenas for investigatory purposes is created solely by statute." *Id.* At 696; *accord United States v. LaSalle Nat'l Bank,* 437 U.S. 298, 307 (1978). Indeed, counsel to the State Board has recognized that although the State and regional water boards have broad authority to investigate water quality, such authority is limited to actions "*authorized or required under* Porter-Cologne." State Water Resources Control Board Chief Counsel's

Statement for California's Nonpoint Source Pollution Control Program, Appendix B: Legal Opinions (citing Water Code, § 13267(a)); *see also Wildlife Alive v. Chickering*, 553 P.2d 537, 540 (Cal. 1976) (reasoning that "in the grants (of powers) and in the regulation of the mode of exercise, there is an implied negative; an implication that no other than the expressly granted power passes by the grant; that it is to be exercised only in the prescribed mode").

More importantly, California has vested authority over air emissions with local and regional air pollution control and air quality management districts located throughout the state (in Los Angeles, the SCAQMD). These air districts are "primarily responsible for control of air pollution from ***all*** sources, other than emission from motor vehicles." Health & Saf. Code, §§ 39002, 40000 (emphasis added). Where a statute includes a grant of authority to one agency, it is presumed that the grant of authority extends only to that agency. Thus, the granting of exclusive authority implies the negative: that other agencies do not have such authority and any action taken by such other agencies cannot conflict or interfere with such authority. *See State Highway Com. v. Rawson*, 312 P.2d 849, 864 (Or. 1957) (rejecting construction of statute that would allow for interference and obstruction of one state agency by another in the latter's exercise of its statutory powers and duties). By placing authority to regulate stationary source emissions exclusively within the province of the air districts, the Legislature withheld such authority from the water boards, even in those instances where such emissions could be shown to adversely affect water quality.

In conclusion, no court has ever addressed whether air emissions are "discharges" under the Porter-Cologne Act and common sense dictates otherwise. If and when this question is ever presented, Petitioners submit the courts will be guided by the principles and precedents set forth herein and will not expand the Water Code in this ill-considered manner. If the Water Board wishes to compel an investigation (or regulation) of aerial deposition as a source of water pollution, it must go back to the Legislature and seek to obtain this authority. The legislative process can then be used — as it should be — to vet the advantages and disadvantages of this approach and to evaluate the myriad of interests

and considerations that bear upon the ultimate policy decision of whether to expand the water boards' authority in so significant a manner.

III. THE TMDL PROGRAM DOES NOT PROVIDE THE WATER BOARD AUTHORITY TO ORDER PRIVATE PARTIES TO INVESTIGATE SOURCES OF AIR EMISSIONS UNDER SECTION 13267.

A TMDL is essentially a pollutant "budget" which (i) determines the total amount of a pollutant that the water body can accept while still achieving the applicable water quality standard, and (ii) allocates that total amount among all sources of the pollutant, including "point sources" (*e.g.*, industrial and municipal wastewater discharges) and "non-point sources" (*e.g.*, storm water runoff and agriculture). *See* 40 C.F.R. § 130.7.[16] Petitioners acknowledge that EPA considers sources of atmospheric deposition to be nonpoint sources under the TMDL program. *See Draft Guidance for Water Quality Based Decisions: The TMDL Process (Second Edition)* (EPA August 1999, EPA-84-D-99-0001) ("*Draft EPA TMDL Guidance*"), at Chapter 3.1.[17]

Nevertheless, "a TMDL does not, by itself, prohibit any conduct or require any actions. Instead, each TMDL represents a goal that may be implemented by adjusting pollutant discharge requirements in individual NPDES permits or establishing nonpoint source controls." *City of Arcadia v. EPA*, 265 F.Supp.2d 1142, 1145 (N.D. Cal 2003). "Thus, a TMDL forms the basis for ***further*** administrative actions that may require or prohibit conduct with respect to particularized pollutant discharges and waterbodies." *Id.* (emphasis added). In other words, the TMDL process, in and of itself, does not imbue the State or regional water boards with any new authority. Rather, TMDLs must be developed and implemented through existing regulatory programs (or through newly developed programs if authorized by law and duly adopted in accordance with the Administrative

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[16] TMDLs can be established for waterbodies impacted solely from non-point sources. *See Pronsolino v. Nastri*, 291 F.3d 1123, 1139-41 (9th Cir. 2002).

[17] Interestingly, in 2002, the definition of "load allocation" (*i.e.*, the portion of the total load allocated to a non-point source) included "atmospheric deposition" but that phrase was deleted from the definition in 2003.

Procedures Act). As EPA guidance points out, the TMDL implementation plan "must contain a *description of the legal authorities under which implementation will occur.* These authorities include, but are not limited to, NPDES, § 401 certification, Federal Land Policy Management Act § 202, the [Coastal Zone Act Reauthorization Amendments], State forest practices acts, CWA § 319 management programs, and various State, Territorial, Trial and local programs." *Draft EPA TMDL Guidance*, at Chapter 3.1 (emphasis added). The reduction goals (or allocations) in a TMDL are enforceable only to the extent legal authority exists to achieve the reductions. Insofar as air emissions are concerned, this authority does not reside in Water Code section 13267 or any other provision of the Water Code.[18]

IV. PRACTICAL CONSIDERATIONS MILITATE STRONGLY AGAINST ALLOWING THE WATER BOARDS TO INVESTIGATE AIR EMISSIONS ON AN AD HOC BASIS.

EPA has long recognized the technical difficulties associated with implementing a program for regulating atmosphere deposition as part of a TMDL program. *See* 64 Fed. Reg. at 46,022-23 (August 23, 1999) ("EPA recognizes that data, analytical approaches and models to establish TMDLs for pollutants originating from air deposition may not be immediately available, especially for pollutants subject to long range transport in the atmosphere"); *see also Technical Guidance Manual for Developing Total Maximum Daily*

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[18] Several TMDLs recently approved by EPA include load allocations for nonpoint sources of atmospheric deposition. *See, e.g., Minnesota Statewide Total Maximum Daily Load, Minnesota Pollution Control Agency* (approved by EPA, March 27, 2007) ("*Minnesota TMDL*"); *Total Maximum Daily Load (TMDL) For Total Mercury in Fish Tissue Residue In the Middle & Lower Savannah River Watershed* U.S. EPA, Region IV (February 28, 2001) ("*Savannah River TMDL*") However, implementation of plans to reduce emissions causing air deposition did not come from regulatory programs administered by state water agencies. Rather, these TMDLs proposed that reductions in air emissions be accomplished pursuant to state and federal *air* regulatory programs. *See, e.g., Savannah River TMDL*, at 9 ("EPA expects that emissions of mercury from air sources (and consequently deposition of mercury to the Savannah River) will continue to be reduced during [] this TMDL through implementation of the CAA's [] regulations. . . . EPA is considering additional regulatory actions under the CAA that may result in further reductions of mercury emissions from air sources.").

Loads, Book II: Part 1, at 2-3. ("The control of atmospheric deposition is usually addressed in regional and national programs and should be considered as part of the uncontrollable load for typical TMDL development").

The 13267 Requirement Letters, and the NRDC petition which triggered their issuance, selectively focus on a tiny fraction of local sources that potentially may contribute to direct and indirect air deposition to surface waters in the region. The Los Angeles Basin contains over four million residents and their motor vehicles, as well as many thousands of small and large business operations. One recent study demonstrates that dust from paved roads, containing contaminants from vehicle exhaust and vehicle brake and tire wear, represents the largest source of particle-associated metals emitted to the atmosphere and locally deposited. *See* Sabin et al. (2006), attached as Exhibit 6.[19] Moreover, air deposition is not merely a local phenomenon. On the contrary, pollutants deposited to surface waters in California have been traced to distant sources in Asia. *See, e.g.*, Steding and Flagle (2002), abstract attached as Exhibit 7.

Taken together, the myriad local and global sources of air emissions contribute far more to air deposition than the sources which NRDC, followed by the Water Board, chose to single out. NRDC's letter identified these facilities on the basis of Toxic Release Inventory (TRI) data reported to EPA. All that the TRI data indicate is that those individual stationary sources reported greater emissions of the specified chemicals as compared to other stationary sources. This result does not, by itself, convert stationary sources into a major source of air deposition.

The 13267 Requirement Letter states no rational basis to assume that its requirement for air deposition studies by a few facilities will provide any useful information for addressing the actual effects of air deposition on water quality. A proper study would need

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[19] NRDC cites an earlier study by Sabin et al. to imply that air emissions from the facilities it identified are a substantial source of deposition to water bodies in Los Angeles. *See* NRDC letter, page 6, n.33. On the contrary, the earlier study cited by NRDC did not investigate the sources of air deposition, while the Sabin et al. study attached as Exhibit 6 identifies road dust as the largest source.

to address all significant sources of deposition and would require the joint efforts of a wide variety of agencies, municipalities and other entities. By contrast, focusing on a few facilities, on an ad hoc basis, is unlikely to yield any substantial benefit.

REQUEST FOR RELIEF

For the reasons set forth above, Petitioners respectfully request that the State Board grant Petitioners the following relief:

A. That the 13267 Requirement Letters issued to Refinery Petitioners be rescinded by the State Board.

B. Such other relief as the State Board may deem just and proper.

Dated: June 14, 2007.

PILLSBURY WINTHROP SHAW PITTMAN LLP
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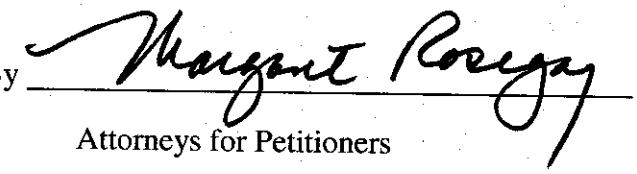
By 

Attorneys for Petitioners

VERIFICATION

I, Michael D. Wang, am Senior Advisor, Southern California, for the Western States Petroleum Association and have responsibility for oversight of water quality regulatory and policy matters at WSPA member facilities located in the Los Angeles Area. I have read the foregoing Verified Petition for Review and Request for Hearing and believe that the statements made therein are true and correct. If called as a witness to testify with respect to the matters stated therein, I could and would competently do so under oath.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this verification was executed in Los Angeles, California, on June 14, 2007.

Michael D. Wang

California Regional Water Quality Control Board
Los Angeles Region

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640 - Internet Address: http://www.waterboards.ca.gov/losangeles

Linda S. Adams
Cal/EPA Secretary

Arnold Schwarzenegger
Governor

May 15, 2007

Shirley Tea
Chevron Products Co.
Chevron USA Inc
324 W. El Segundo Blvd.
El Segundo, CA 90245

REQUIREMENT UNDER CALIFORNIA WATER CODE SECTION 13267 FOR SUBMITTAL OF TECHNICAL REPORTS ON THE FATE AND TRANSPORT OF METALS EMITTED FROM THE CHEVRON PRODUCTS CO., EL SEGUNDO REFINERY

Dear Ms. Tea:

The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) is the public agency with primary responsibility for the protection of ground and surface water quality within major portions of Los Angeles and Ventura Counties. As part of our efforts to protect water quality, pursuant to California Water Code (CWC) Section 13267, the Regional Board is investigating the fate and transport of metals emitted from the Chevron Products Co., El Segundo Refinery. The Regional Board is interested in discharges of metals from atmospheric deposition to the Santa Monica Bay Watershed Management Area and other watersheds within the Los Angeles Region.

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the Chevron Products Co., El Segundo Refinery is a significant source of mercury and zinc emitted to the atmosphere. Some portion of these emissions then enters the waterbodies via direct deposition to a waterbody surface or deposition to the watershed and subsequent transportation to a waterbody via urban runoff.

CWC §13267 provides the Regional Board with the authority to require the Chevron Products Co., El Segundo Refinery to furnish, under penalty of perjury, technical reports that the Regional Board requires. The El Segundo Refinery currently discharges waste under NPDES Permit No. CA0000337, Order No. R4-2006-0089. Pursuant to CWC §13267, you are hereby required to submit a technical report that evaluates the fate and transport of atmospheric emissions of metals as they relate to either direct or indirect deposition to the Santa Monica Bay Watershed Management Area. The report shall be based on a sampling and analysis program that accounts for intra- and inter-annual variability in emissions.

The desired outcomes of the report are:

- An estimate of the total mass of mercury and zinc emitted directly to the atmosphere per year from the El Segundo Refinery.
- A thorough discussion of the estimation methodology, uncertainties in the estimate, and assumptions used in the calculation of the total mass emitted.
- A discussion of the fate of these emitted metals and an estimate of how much of these metals are discharged to the Santa Monica Bay via direct or indirect deposition[1]. Along with a discussion of the basis for these estimates, include a thorough discussion of estimation methodology, uncertainties in the estimates, and assumptions used in the calculations of the fate and transport of these metals. If it is determined that metals are deposited in other watersheds in the Los Angeles Region, include these results as well.

Need for Technical Report

The waterbodies in the Santa Monica Bay Watershed Management Area are impaired by metals and are included on the Clean Water Act Section 303(d) list for metals in the water column and sediment. The Ballona Creek TMDL is effective as of January 11, 2006. The Marina del Rey TMDL is effective as of March 22, 2006.

The Regional Board needs the information in the required reports to assess the significance of atmospheric deposition as a source of metals discharged to the Santa Monica Bay Watershed Management Area. In addition, this information will help to adapt implementation actions for facilities to reduce, if necessary, metals loading as part of the Ballona Creek and Marina del Rey TMDLs. The contribution of direct and indirect atmospheric deposition of metals is a source of uncertainty that needs to be resolved for successful TMDL implementation.

Dry deposition of metals represents a major loading pathway in arid regions like Los Angeles, where wet deposition is limited due to limited precipitation.[2] In a study conducted by Sabin et al.[2] indirect dry deposition to the land surface within a watershed had the potential to be a large influence on the quality of storm water runoff. Particles that deposit on urban surfaces during dry weather can be easily mobilized by surface flows during storms due to the extensive impervious

[1] Direct atmospheric deposition is the deposition of pollutants directly to the surface of a waterbody. Indirect atmospheric deposition is the process by which pollutants deposited on the land surface may be washed off during storm events or by urban runoff and delivered to a waterbody.

[2] Sabin, L.D., K. Schiff, J.H. Lim and K.D. Stolzenbach. 2004. *Atmospheric dry deposition of trace metals in the Los Angeles coastal region.*

urban areas. Mean deposition of metals to the surface area of the Ballona Creek watershed, the largest subwatershed of the Santa Monica Bay Watershed Management Area, was calculated to be 13,000 kg/year for zinc.[2] In addition, Sabin[2] calculated the ratio of storm water runoff to indirect atmospheric deposition as 29% for zinc.[2]

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the Chevron Products Co., El Segundo Refinery released atmospheric emissions of 13 lbs of mercury and 1,069 lbs of zinc in 2004.[3] Research strongly suggests that a portion of these emissions is being discharged either directly or indirectly, into Los Angeles water bodies through atmospheric deposition. One study found that about 95% of emissions in Santa Monica Bay come from emission sources in Los Angeles County, and that 99% of lead found in Santa Monica Bay entered the Bay through atmospheric deposition.[4]

Burden and Cost of Technical Report

The Chevron Products Co. already calculates and keeps records of emissions of metals as part of their federal Toxics Release Inventory requirements and South Coast Air Quality Management District (AQMD) annual emissions reporting requirements. The cost of providing these estimates to the Regional Board is therefore minimal. The effort to calculate the fate of these emitted metals and to estimate how much of these metals would be discharged to the Santa Monica Bay Watershed Management Area may present an additional cost. Such an estimate may require air dispersion modeling and an estimation of the deposition of metals to land and water surfaces. Air deposition flux rates can be determined from literature values. EPA-approved dispersion model programs are available from www.epa.gov/scram001. Assuming that one person can perform the necessary air dispersion modeling and deposition estimates in two months, then the time to perform the analysis is approximately 340 hours. Therefore, assuming a burdened hourly rate of $100 per hour, the estimated cost for this analysis would be $34,000.

Because the El Segundo Refinery already conducts air dispersion modeling as part of the preparation of health risk assessments under the requirements of the California Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588), the additional cost of conducting air dispersion modeling is minimal. Therefore, the burden, including the cost, of the technical report bears a reasonable relationship to the need for and benefits to be obtained from the technical report.

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[3] EPA Toxics Release Inventory. 2004. Web site http://www.epa.gov/triexplorer/statefactsheet.htm.

[4] Stolzenbach, K.D., R. Lu, C. Xiong, S. Friedlander, R. Turco, K. Schiff and L. Tiefenthaler. 2001. *Measuring and Modeling of Atmospheric Deposition and Santa Monica Bay and the Santa Monica Bay Watershed.*

Pursuant to CWC §13267, Chevron Produts Co., El Segundo Refinery must submit the required technical report by **September 7, 2007**. Furthermore, pursuant to §13268 (b)(1) of the CWC failure to submit the required report may result in the imposition of civil liability penalties by the Regional Board of up to $1,000.00 per day for each day the report is not received after the **September 7, 2007** due date. These civil liabilities may be assessed by the Regional Board for failure to comply, beginning with the date that the violations first occurred, and without further warning.

If you have any questions, please contact Mr. Sam Unger at (213) 576-6622 or alternatively, Ms. Rebecca Christmann at (213) 576-6757 regarding this matter.

Sincerely,

Deborah J. Smith
Interim Executive Officer

cc: Mr. Michael Levy Esq., Office of Chief Counsel, State Water Resources Control Board
Mr. Bruce Fujimoto, Division of Water Quality, State Water Resources Control Board
Mr. Gerald Bowes, Division of Water Quality, State Water Resources Control Board
Ms. Kathi Moore, Office of the Director, Water Division, U.S. EPA Region IX
Mr. Eugene Bromley, CWA Standards and Permits, U.S. EPA Region IX
Ms. Elaine Chang, Deputy Executive Officer for Planning, Rule Development, and Area Sources, South Coast Air Quality Management District
Mr. David Beckman, Natural Resources Defense Council

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Linda S. Adams
Cal/EPA Secretary

Arnold Schwarzenegger
Governor

May 15, 2007

Paul Langland
ConocoPhillips,
Los Angeles Refinery, Carson Plant
1520 E. Sepulveda Blvd.
Carson, CA 90745

REQUIREMENT UNDER CALIFORNIA WATER CODE SECTION 13267 FOR SUBMITTAL OF TECHNICAL REPORTS ON THE FATE AND TRANSPORT OF METALS EMITTED FROM CONOCOPHILLIPS, LOS ANGELES REFINERY, CARSON PLANT

Dear Mr. Langland:

The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) is the public agency with primary responsibility for the protection of ground and surface water quality within major portions of Los Angeles and Ventura Counties. As part of our efforts to protect water quality, pursuant to California Water Code (CWC) Section 13267, the Regional Board is investigating the fate and transport of metals emitted from the ConocoPhillips, Los Angeles Refinery, Carson Plant. The Regional Board is interested in discharges of metals from atmospheric deposition to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area and other watersheds within the Los Angeles Region.

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the ConocoPhillips, Los Angeles Refinery, Carson Plant is a significant source of mercury emitted to the atmosphere. Some portion of these emissions then enters the waterbodies via direct deposition to a waterbody surface or deposition to the watershed and subsequent transportation to a waterbody via urban runoff.

CWC §13267 provides the Regional Board with the authority to require the ConocoPhillips, Los Angeles Refinery, Carson Plant to furnish, under penalty of perjury, technical reports that the Regional Board requires. The Carson Plant currently discharges waste under NPDES Permit No. CA0063185, Order No. R4-2006-0082. Pursuant to CWC §13267, you are hereby required to submit a technical report that evaluates the fate and transport of atmospheric emissions of metals as they relate to either direct or indirect deposition to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area. The report shall be based on a sampling and

analysis program that accounts for intra- and inter-annual variability in emissions. The desired outcomes of the report are:

- An estimate of the total mass of mercury emitted directly to the atmosphere per year from the Carson Plant.
- A thorough discussion of the estimation methodology, uncertainties in the estimate, and assumptions used in the calculation of the total mass emitted.
- A discussion of the fate of these emitted metals and an estimate of how much of these metals are discharged to the Dominguez Channel, and Los Angeles and Long Beach Harbors via direct or indirect deposition[1]. Along with a discussion of the basis for these estimates, include a thorough discussion of estimation methodology, uncertainties in the estimates, and assumptions used in the calculations of the fate and transport of these metals. If it is determined that metals are deposited in other watersheds in the Los Angeles Region, include these results as well.

Need for Technical Report

The waterbodies in the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area are impaired by metals and are included on the 2006 Clean Water Act Section 303(d) list for metals in the water column, tissue, and sediment as well as for benthic community effects and sediment toxicity. The Regional Board is developing Total Maximum Daily Loads (TMDLs) to address these impairments. The Dominguez Channel, Los Angeles and Long Beach Harbors TMDL is scheduled for Regional Board consideration in 2008.

The Regional Board needs the information in the required reports to assess the significance of atmospheric deposition as a source of metals discharged to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area. In addition, this information will help to adapt implementation actions for facilities to reduce, if necessary, metals loading as part of the upcoming Dominguez Channel, Los Angeles and Long Beach Harbors TMDLs. The contribution of direct and indirect atmospheric deposition of metals is a source of uncertainty that needs to be resolved for successful TMDL development and implementation.

Dry deposition of metals represents a major loading pathway in arid regions like Los Angeles, where wet deposition is limited due to limited precipitation.[2] In a study conducted by Sabin et

[1] Direct atmospheric deposition is the deposition of pollutants directly to the surface of a waterbody. Indirect atmospheric deposition is the process by which pollutants deposited on the land surface may be washed off during storm events or by urban runoff and delivered to a waterbody.

[2] Sabin, L.D., K. Schiff, J.H. Lim and K.D. Stolzenbach. 2004. *Atmospheric dry deposition of trace metals in the Los Angeles coastal region.*

al.[2] indirect dry deposition to the land surface within a watershed had the potential to be a large influence on the quality of storm water runoff. Particles that deposit on urban surfaces during dry weather can be easily mobilized by surface flows during storms due to the extensive impervious urban areas. Mean deposition of metals to the surface area of the Dominguez Channel watershed was calculated to be 2,100 kilograms per year (kg/year) for copper, 1,600 kg/year for lead, and 9,400 kg/year for zinc.[2] In addition, Sabin[2] calculated the ratio of storm water runoff to indirect atmospheric deposition as 31% for copper, 14% for lead, and 43% for zinc.[2]

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the ConocoPhillips, Los Angeles Refinery, Carson Plant released atmospheric emissions of 2 pounds (lbs) of mercury.[3] Research strongly suggests that a portion of these emissions is being discharged either directly or indirectly, into Los Angeles water bodies through atmospheric deposition. One study found that about 95% of emissions in Santa Monica Bay come from emission sources in Los Angeles County, and that 99% of lead found in Santa Monica Bay entered the Bay through atmospheric deposition.[4]

Burden and Cost of Technical Report

The ConocoPhillips Carson Plant already calculates and keeps records of emissions of metals as part of their federal Toxics Release Inventory requirements and South Coast Air Quality Management District (AQMD) annual emissions reporting requirements. The cost of providing these estimates to the Regional Board is therefore minimal. The effort to calculate the fate of these emitted metals and to estimate how much of these metals would be discharged to the Dominguez Channel, Los Angeles and Long Beach Harbors may present an additional cost. Such an estimate may require air dispersion modeling and an estimation of the deposition of metals to land and water surfaces. Air deposition flux rates can be determined from literature values. EPA-approved dispersion model programs are available from www.epa.gov/scram001. Assuming that one person can perform the necessary air dispersion modeling and deposition estimates in two months, then the time to perform the analysis is approximately 340 hours. Therefore, assuming a burdened hourly rate of $100 per hour, the estimated cost for this analysis would be $34,000.

Because the Carson Plant already conducts air dispersion modeling as part of the preparation of health risk assessments under the requirements of the California Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588), the additional cost of conducting air

[3] EPA Toxics Release Inventory. 2004. Web site http://www.epa.gov/triexplorer/statefactsheet.htm.

[4] Stolzenbach, K.D., R. Lu, C. Xiong, S. Friedlander, R. Turco, K. Schiff and L. Tiefenthaler. 2001. *Measuring and Modeling of Atmospheric Deposition and Santa Monica Bay and the Santa Monica Bay Watershed.*

dispersion modeling is minimal. Therefore, the burden, including the cost, of the technical report bears a reasonable relationship to the need for and benefits to be obtained from the technical report.

Pursuant to CWC §13267, the ConocoPhillips, Los Angeles Refinery, Carson Plant must submit the required technical report by **September 7, 2007**. Furthermore, pursuant to §13268 (b)(1) of the CWC failure to submit the required report may result in the imposition of civil liability penalties by the Regional Board of up to $1,000.00 per day for each day the report is not received after the **September 7, 2007** due date. These civil liabilities may be assessed by the Regional Board for failure to comply, beginning with the date that the violations first occurred, and without further warning.

If you have any questions, please contact Mr. Sam Unger at (213) 576-6622 or alternatively, Ms. Rebecca Christmann at (213) 576-6757 regarding this matter.

Sincerely,

Deborah J. Smith
Interim Executive Officer

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May 15, 2007

Paul Langland
ConocoPhillips
Los Angeles Marine Terminal
150 Pier A Street
Wilmington, CA 90744

REQUIREMENT UNDER CALIFORNIA WATER CODE SECTION 13267 FOR SUBMITTAL OF TECHNICAL REPORTS ON THE FATE AND TRANSPORT OF METALS EMITTED FROM THE CONOCOPHILLIPS, LOS ANGELES MARINE TERMINAL

Dear Mr. Langland:

The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) is the public agency with primary responsibility for the protection of ground and surface water quality within major portions of Los Angeles and Ventura Counties. As part of our efforts to protect water quality, pursuant to California Water Code (CWC) Section 13267, the Regional Board is investigating the fate and transport of metals emitted from the ConocoPhillips, Los Angeles Marine Terminal. The Regional Board is interested in discharges of metals from atmospheric deposition to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area and other watersheds within the Los Angeles Region.

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the ConocoPhillips, Los Angeles Marine Terminal is a significant source of mercury and zinc emitted to the atmosphere. Some portion of these emissions then enters the waterbodies via direct deposition to a waterbody surface or deposition to the watershed and subsequent transportation to a waterbody via urban runoff.

CWC §13267 provides the Regional Board with the authority to require the ConocoPhillips, Los Angeles Marine Terminal to furnish, under penalty of perjury, technical reports that the Regional Board requires. Pursuant to CWC §13267, you are hereby required to submit a technical report that evaluates the fate and transport of atmospheric emissions of metals as they relate to either direct or indirect deposition to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area. The report shall be based on a sampling and

analysis program that accounts for intra- and inter-annual variability in emissions. The desired outcomes of the report are:

- An estimate of the total mass of mercury and zinc emitted directly to the atmosphere per year from the Los Angeles Marine Terminal.
- A thorough discussion of the estimation methodology, uncertainties in the estimate, and assumptions used in the calculation of the total mass emitted.
- A discussion of the fate of these emitted metals and an estimate of how much of these metals are discharged to the Dominguez Channel, and Los Angeles and Long Beach Harbors via direct or indirect deposition[1]. Along with a discussion of the basis for these estimates, include a thorough discussion of estimation methodology, uncertainties in the estimates, and assumptions used in the calculations of the fate and transport of these metals. If it is determined that metals are deposited in other watersheds in the Los Angeles Region, include these results as well.

Need for Technical Report

The waterbodies in the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area are impaired by metals and are included on the 2006 Clean Water Act Section 303(d) list for metals in the water column, tissue, and sediment as well as for benthic community effects and sediment toxicity. The Regional Board is developing Total Maximum Daily Loads (TMDLs) to address these impairments. The Dominguez Channel, Los Angeles and Long Beach Harbors TMDL is scheduled for Regional Board consideration in 2008.

The Regional Board needs the information in the required reports to assess the significance of atmospheric deposition as a source of metals discharged to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area. In addition, this information will help to adapt implementation actions for facilities to reduce, if necessary, metals loading as part of the upcoming Dominguez Channel, Los Angeles and Long Beach Harbors TMDLs. The contribution of direct and indirect atmospheric deposition of metals is a source of uncertainty that needs to be resolved for successful TMDL development and implementation.

Dry deposition of metals represents a major loading pathway in arid regions like Los Angeles, where wet deposition is limited due to limited precipitation.[2] In a study conducted by Sabin et

[1] Direct atmospheric deposition is the deposition of pollutants directly to the surface of a waterbody. Indirect atmospheric deposition is the process by which pollutants deposited on the land surface may be washed off during storm events or by urban runoff and delivered to a waterbody.

[2] Sabin, L.D., K. Schiff, J.H. Lim and K.D. Stolzenbach. 2004. *Atmospheric dry deposition of trace metals in the Los Angeles coastal region.*

al.[2] indirect dry deposition to the land surface within a watershed had the potential to be a large influence on the quality of storm water runoff. Particles that deposit on urban surfaces during dry weather can be easily mobilized by surface flows during storms due to the extensive impervious urban areas. Mean deposition of metals to the surface area of the Dominguez Channel watershed was calculated to be 2,100 kilograms per year (kg/year) for copper, 1,600 kg/year for lead, and 9,400 kg/year for zinc.[2] In addition, Sabin[2] calculated the ratio of storm water runoff to indirect atmospheric deposition as 31% for copper, 14% for lead, and 43% for zinc.[2]

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the ConocoPhillips, Los Angeles Marine Terminal released atmospheric emissions of 4 pounds (lbs) of mercury and 750 lbs of zinc in 2004.[3] Research strongly suggests that a portion of these emissions is being discharged either directly or indirectly, into Los Angeles water bodies through atmospheric deposition. One study found that about 95% of emissions in Santa Monica Bay come from emission sources in Los Angeles County, and that 99% of lead found in Santa Monica Bay entered the Bay through atmospheric deposition.[4]

Burden and Cost of Technical Report

ConocoPhillips, Los Angeles Marine Terminal already calculates and keeps records of emissions of metals as part of their federal Toxics Release Inventory requirements and South Coast Air Quality Management District (AQMD) annual emissions reporting requirements. The cost of providing these estimates to the Regional Board is therefore minimal. The effort to calculate the fate of these emitted metals and to estimate how much of these metals would be discharged to the Dominguez Channel, Los Angeles and Long Beach Harbors may present an additional cost. Such an estimate may require air dispersion modeling and an estimation of the deposition of metals to land and water surfaces. Air deposition flux rates can be determined from literature values. EPA-approved dispersion model programs are available from www.epa.gov/scram001. Assuming that one person can perform the necessary air dispersion modeling and deposition estimates in two months, then the time to perform the analysis is approximately 340 hours. Therefore, assuming a burdened hourly rate of $100 per hour, the estimated cost for this analysis would be $34,000.

Because the Los Angeles Marine Terminal already conducts air dispersion modeling as part of the preparation of health risk assessments under the requirements of the California Air Toxics

[3] EPA Toxics Release Inventory. 2004. Web site http://www.epa.gov/triexplorer/statefactsheet.htm.

[4] Stolzenbach, K.D., R. Lu, C. Xiong, S. Friedlander, R. Turco, K. Schiff and L. Tiefenthaler. 2001. *Measuring and Modeling of Atmospheric Deposition and Santa Monica Bay and the Santa Monica Bay Watershed.*

"Hot Spots" Information and Assessment Act of 1987 (AB 2588), the additional cost of conducting air dispersion modeling is minimal. Therefore, the burden, including the cost, of the technical report bears a reasonable relationship to the need for and benefits to be obtained from the technical report.

Pursuant to CWC §13267, ConocoPhillips, Los Angeles Marine Terminal must submit the required technical report by **September 7, 2007**. Furthermore, pursuant to §13268 (b)(1) of the CWC failure to submit the required report may result in the imposition of civil liability penalties by the Regional Board of up to $1,000.00 per day for each day the report is not received after the **September 7, 2007** due date. These civil liabilities may be assessed by the Regional Board for failure to comply, beginning with the date that the violations first occurred, and without further warning.

If you have any questions, please contact Mr. Sam Unger at (213) 576-6622 or alternatively, Ms. Rebecca Christmann at (213) 576-6757 regarding this matter.

Sincerely,

Deborah J. Smith
Interim Executive Officer

cc: Mr. Michael Levy Esq., Office of Chief Counsel, State Water Resources Control Board
Mr. Bruce Fujimoto, Division of Water Quality, State Water Resources Control Board
Mr. Gerald Bowes, Division of Water Quality, State Water Resources Control Board
Ms. Kathi Moore, Office of the Director, Water Division, U.S. EPA Region IX
Mr. Eugene Bromley, CWA Standards and Permits, U.S. EPA Region IX
Ms. Elaine Chang, Deputy Executive Officer for Planning, Rule Development, and Area Sources, South Coast Air Quality Management District
Mr. David Beckman, Natural Resources Defense Council

California Regional Water Quality Control Board
Los Angeles Region

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640 - Internet Address: http://www.waterboards.ca.gov/losangeles

Linda S. Adams
Cal/EPA Secretary

Arnold Schwarzenegger
Governor

May 15, 2007

Carolin A. Keith
ExxonMobil Oil Corporation
Torrance Refinery
3700 West 190th St.
Torrance, CA 90509

REQUIREMENT UNDER CALIFORNIA WATER CODE SECTION 13267 FOR SUBMITTAL OF TECHNICAL REPORTS ON THE FATE AND TRANSPORT OF METALS EMITTED FROM THE EXXONMOBIL OIL CORPORATION, TORRANCE REFINERY

Dear Ms. Keith:

The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) is the public agency with primary responsibility for the protection of ground and surface water quality within major portions of Los Angeles and Ventura Counties. As part of our efforts to protect water quality, pursuant to California Water Code (CWC) Section 13267, the Regional Board is investigating the fate and transport of metals emitted from the ExxonMobil Oil Corporation, Torrance Refinery. The Regional Board is interested in discharges of metals from atmospheric deposition to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area and other watersheds within the Los Angeles Region.

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the ExxonMobil Corporation, Torrance Refinery is a significant source of copper, lead, mercury, and zinc emitted to the atmosphere. Some portion of these emissions then enters the waterbodies via direct deposition to a waterbody surface or deposition to the watershed and subsequent transportation to a waterbody via urban runoff.

CWC §13267 provides the Regional Board with the authority to require the ExxonMobil Corporation, Torrance Refinery to furnish, under penalty of perjury, technical reports that the Regional Board requires. The Torrance Refinery currently discharges waste under NPDES Permit No. CA0055387, Order No. R4-2001-129. Pursuant to CWC §13267, you are hereby required to submit a technical report that evaluates the fate and transport of atmospheric emissions of metals as they relate to either direct or indirect deposition to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area. The report shall

be based on a sampling and analysis program that accounts for intra- and inter-annual variability in emissions. The desired outcomes of the report are:

- An estimate of the total mass of copper, lead, mercury, and zinc emitted directly to the atmosphere per year from the Torrance Refinery.
- A thorough discussion of the estimation methodology, uncertainties in the estimate, and assumptions used in the calculation of the total mass emitted.
- A discussion of the fate of these emitted metals and an estimate of how much of these metals are discharged to the Dominguez Channel, and Los Angeles and Long Beach Harbors via direct or indirect deposition[1]. Along with a discussion of the basis for these estimates, include a thorough discussion of estimation methodology, uncertainties in the estimates, and assumptions used in the calculations of the fate and transport of these metals. If it is determined that metals are deposited in other watersheds in the Los Angeles Region, include these results as well.

Need for Technical Report

The waterbodies in the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area are impaired by metals and are included on the 2006 Clean Water Act Section 303(d) list for metals in the water column, tissue, and sediment as well as for benthic community effects and sediment toxicity. The Regional Board is developing Total Maximum Daily Loads (TMDLs) to address these impairments. The Dominguez Channel, Los Angeles and Long Beach Harbors TMDL is scheduled for Regional Board consideration in 2008.

The Regional Board needs the information in the required reports to assess the significance of atmospheric deposition as a source of metals discharged to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area. In addition, this information will help to adapt implementation actions for facilities to reduce, if necessary, metals loading as part of the upcoming Dominguez Channel, Los Angeles and Long Beach Harbors TMDLs. The contribution of direct and indirect atmospheric deposition of metals is a source of uncertainty that needs to be resolved for successful TMDL development and implementation.

Dry deposition of metals represents a major loading pathway in arid regions like Los Angeles, where wet deposition is limited due to limited precipitation.[2] In a study conducted by Sabin et

[1] Direct atmospheric deposition is the deposition of pollutants directly to the surface of a waterbody. Indirect atmospheric deposition is the process by which pollutants deposited on the land surface may be washed off during storm events or by urban runoff and delivered to a waterbody.

[2] Sabin, L.D., K. Schiff, J.H. Lim and K.D. Stolzenbach. 2004. *Atmospheric dry deposition of trace metals in the Los Angeles coastal region.*

al.[2] indirect dry deposition to the land surface within a watershed had the potential to be a large influence on the quality of storm water runoff. Particles that deposit on urban surfaces during dry weather can be easily mobilized by surface flows during storms due to the extensive impervious urban areas. Mean deposition of metals to the surface area of the Dominguez Channel watershed was calculated to be 2,100 kilograms per year (kg/year) for copper, 1,600 kg/year for lead, and 9,400 kg/year for zinc.[2] In addition, Sabin[2] calculated the ratio of storm water runoff to indirect atmospheric deposition as 31% for copper, 14% for lead, and 43% for zinc.[2]

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the ExxonMobil Corporation, Torrance Refinery released atmospheric emissions of 836 pounds (lbs) of copper, 212 lbs of lead, 115 lbs of mercury, and 13,350 lbs of zinc in 2004.[3] Research strongly suggests that a portion of these emissions is being discharged either directly or indirectly, into Los Angeles water bodies through atmospheric deposition. One study found that about 95% of emissions in Santa Monica Bay come from emission sources in Los Angeles County, and that 99% of lead found in Santa Monica Bay entered the Bay through atmospheric deposition.[4]

Burden and Cost of Technical Report

The ExxonMobil Corporation already calculates and keeps records of emissions of metals as part of their federal Toxics Release Inventory requirements and South Coast Air Quality Management District (AQMD) annual emissions reporting requirements. The cost of providing these estimates to the Regional Board is therefore minimal. The effort to calculate the fate of these emitted metals and to estimate how much of these metals would be discharged to the Dominguez Channel, Los Angeles and Long Beach Harbors may present an additional cost. Such an estimate may require air dispersion modeling and an estimation of the deposition of metals to land and water surfaces. Air deposition flux rates can be determined from literature values. EPA-approved dispersion model programs are available from www.epa.gov/scram001. Assuming that one person can perform the necessary air dispersion modeling and deposition estimates in two months, then the time to perform the analysis is approximately 340 hours. Therefore, assuming a burdened hourly rate of $100 per hour, the estimated cost for this analysis would be $34,000.

Because the Torrance Refinery already conducts air dispersion modeling as part of the preparation of health risk assessments under the requirements of the California Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588), the additional cost of conducting air

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[3] EPA Toxics Release Inventory. 2004. Web site http://www.epa.gov/triexplorer/statefactsheet.htm.

[4] Stolzenbach, K.D., R. Lu, C. Xiong, S. Friedlander, R. Turco, K. Schiff and L. Tiefenthaler. 2001. *Measuring and Modeling of Atmospheric Deposition and Santa Monica Bay and the Santa Monica Bay Watershed.*

dispersion modeling is minimal. Therefore, the burden, including the cost, of the technical report bears a reasonable relationship to the need for and benefits to be obtained from the technical report.

Pursuant to CWC §13267, ExxonMobil Corporation, Torrance Refinery must submit the required technical report by **September 7, 2007**. Furthermore, pursuant to §13268 (b)(1) of the CWC failure to submit the required report may result in the imposition of civil liability penalties by the Regional Board of up to $1,000.00 per day for each day the report is not received after the **September 7, 2007** due date. These civil liabilities may be assessed by the Regional Board for failure to comply, beginning with the date that the violations first occurred, and without further warning.

If you have any questions, please contact Mr. Sam Unger at (213) 576-6622 or alternatively, Ms. Rebecca Christmann at (213) 576-6757 regarding this matter.

Sincerely,

Deborah J. Smith
Interim Executive Officer

cc: Mr. Michael Levy Esq., Office of Chief Counsel, State Water Resources Control Board
Mr. Bruce Fujimoto, Division of Water Quality, State Water Resources Control Board
Mr. Gerald Bowes, Division of Water Quality, State Water Resources Control Board
Ms. Kathi Moore, Office of the Director, Water Division, U.S. EPA Region IX
Mr. Eugene Bromley, CWA Standards and Permits, U.S. EPA Region IX
Ms. Elaine Chang, Deputy Executive Officer for Planning, Rule Development, and Area Sources, South Coast Air Quality Management District
Mr. David Beckman, Natural Resources Defense Council

California Regional Water Quality Control Board
Los Angeles Region

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640 - Internet Address: http://www.waterboards.ca.gov/losangeles

Linda S. Adams
Cal/EPA Secretary

Arnold Schwarzenegger
Governor

May 15, 2007

Mr. Walter W. Neil
BP West Coast Products LLC, Carson
1801 E. Sepulveda Blvd.
Carson, CA 90749

REQUIREMENT UNDER CALIFORNIA WATER CODE SECTION 13267 FOR SUBMITTAL OF TECHNICAL REPORTS ON THE FATE AND TRANSPORT OF METALS EMITTED FROM BP WEST COAST PRODUCTS LLC, CARSON REFINERY

Dear Mr. Neil:

The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) is the public agency with primary responsibility for the protection of ground and surface water quality within major portions of Los Angeles and Ventura Counties. As part of our efforts to protect water quality, pursuant to California Water Code (CWC) Section 13267, the Regional Board is investigating the fate and transport of metals emitted from the BP Carson Refinery. The Regional Board is interested in discharges of metals from atmospheric deposition to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area and other watersheds within the Los Angeles Region.

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the BP Carson Refinery is a significant source of lead, mercury, and zinc emitted to the atmosphere. Some portion of these emissions then enters the waterbodies via direct deposition to a waterbody surface or deposition to the watershed and subsequent transportation to a waterbody via urban runoff.

CWC §13267 provides the Regional Board with the authority to require the BP Carson Refinery to furnish, under penalty of perjury, technical reports that the Regional Board requires. BP Carson Refinery currently discharges waste under NPDES Permit No. CA0000680, Order No. R4-2007-0015. Pursuant to CWC §13267, you are hereby required to submit a technical report that evaluates the fate and transport of atmospheric emissions of metals as they relate to either direct or indirect deposition to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area. The report shall be based on a sampling and analysis program that accounts for intra- and inter-annual variability in emissions.

The desired outcomes of the report are:

- An estimate of the total mass of lead, mercury, and zinc emitted directly to the atmosphere per year from the BP Carson Refinery.
- A thorough discussion of the estimation methodology, uncertainties in the estimate, and assumptions used in the calculation of the total mass emitted.
- A discussion of the fate of these emitted metals and an estimate of how much of these metals are discharged to the Dominguez Channel, and Los Angeles and Long Beach Harbors via direct or indirect deposition[1]. Along with a discussion of the basis for these estimates, include a thorough discussion of estimation methodology, uncertainties in the estimates, and assumptions used in the calculations of the fate and transport of these metals. If it is determined that metals are deposited in other watersheds in the Los Angeles Region, include these results as well.

Need for Technical Report

The waterbodies in the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area are impaired by metals and are included on the 2006 Clean Water Act Section 303(d) list for metals in the water column, tissue, and sediment as well as for benthic community effects and sediment toxicity. The Regional Board is developing Total Maximum Daily Loads (TMDLs) to address these impairments. The Dominguez Channel, Los Angeles and Long Beach Harbors TMDL is scheduled for Regional Board consideration in 2008.

The Regional Board needs the information in the required reports to assess the significance of atmospheric deposition as a source of metals discharged to the Dominguez Channel, Los Angeles and Long Beach Harbors Watershed Management Area. In addition, this information will help to adapt implementation actions for facilities to reduce, if necessary, metals loading as part of the upcoming Dominguez Channel, Los Angeles and Long Beach Harbors TMDLs. The contribution of direct and indirect atmospheric deposition of metals is a source of uncertainty that needs to be resolved for successful TMDL development and implementation.

Dry deposition of metals represents a major loading pathway in arid regions like Los Angeles, where wet deposition is limited due to limited precipitation.[2] In a study conducted by Sabin et al.[2] indirect dry deposition to the land surface within a watershed had the potential to be a large

[1] Direct atmospheric deposition is the deposition of pollutants directly to the surface of a waterbody. Indirect atmospheric deposition is the process by which pollutants deposited on the land surface may be washed off during storm events or by urban runoff and delivered to a waterbody.

[2] Sabin, L.D., K. Schiff, J.H. Lim and K.D. Stolzenbach. 2004. *Atmospheric dry deposition of trace metals in the Los Angeles coastal region.*

influence on the quality of storm water runoff. Particles that deposit on urban surfaces during dry weather can be easily mobilized by surface flows during storms due to the extensive impervious urban areas. Mean deposition of metals to the surface area of the Dominguez Channel watershed was calculated to be 2,100 kilograms per year (kg/year) for copper, 1,600 kg/year for lead, and 9,400 kg/year for zinc.[2] In addition, Sabin[2] calculated the ratio of storm water runoff to indirect atmospheric deposition as 31% for copper, 14% for lead, and 43% for zinc.[2]

Based on information obtained from the US Environmental Protection Agency (EPA) Toxics Release Inventory database, the BP Carson Refinery released atmospheric emissions of 188 pounds (lbs) of lead, 166 lbs of mercury, and 1,330 lbs of zinc in 2004.[3] Research strongly suggests that a portion of these emissions is being discharged either directly or indirectly, into Los Angeles water bodies through atmospheric deposition. One study found that about 95% of emissions in Santa Monica Bay come from emission sources in Los Angeles County, and that 99% of lead found in Santa Monica Bay entered the Bay through atmospheric deposition.[4]

Burden and Cost of Technical Report

The BP Carson Refinery already calculates and keeps records of emissions of metals as part of their federal Toxics Release Inventory requirements and South Coast Air Quality Management District (AQMD) annual emissions reporting requirements. The cost of providing these estimates to the Regional Board is therefore minimal. The effort to calculate the fate of these emitted metals and to estimate how much of these metals would be discharged to the Dominguez Channel, Los Angeles and Long Beach Harbors may present an additional cost. Such an estimate may require air dispersion modeling and an estimation of the deposition of metals to land and water surfaces. Air deposition flux rates can be determined from literature values. EPA-approved dispersion model programs are available from www.epa.gov/scram001. Assuming that one person can perform the necessary air dispersion modeling and deposition estimates in two months, then the time to perform the analysis is approximately 340 hours. Therefore, assuming a burdened hourly rate of $100 per hour, the estimated cost for this analysis would be $34,000.

Because the BP Carson Refinery already conducts air dispersion modeling as part of the preparation of health risk assessments under the requirements of the California Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588), the additional cost of conducting air dispersion modeling is minimal. Therefore, the burden, including the cost, of the technical report

[3] EPA Toxics Release Inventory. 2004. Web site http://www.epa.gov/triexplorer/statefactsheet.htm.

[4] Stolzenbach, K.D., R. Lu, C. Xiong, S. Friedlander, R. Turco, K. Schiff and L. Tiefenthaler. 2001. *Measuring and Modeling of Atmospheric Deposition and Santa Monica Bay and the Santa Monica Bay Watershed.*

bears a reasonable relationship to the need for and benefits to be obtained from the technical report.

Pursuant to CWC §13267, the BP West Coast Products LLC, Carson Refinery must submit the required technical report by **September 7, 2007**. Furthermore, pursuant to §13268 (b)(1) of the CWC failure to submit the required report may result in the imposition of civil liability penalties by the Regional Board of up to $1,000.00 per day for each day the report is not received after the **September 7, 2007** due date. These civil liabilities may be assessed by the Regional Board for failure to comply, beginning with the date that the violations first occurred, and without further warning.

If you have any questions, please contact Mr. Sam Unger at (213) 576-6622 or alternatively, Ms. Rebecca Christmann at (213) 576-6757 regarding this matter.

Sincerely,

Deborah J. Smith
Interim Executive Officer

cc: Mr. Michael Levy Esq., Office of Chief Counsel, State Water Resources Control Board
Mr. Bruce Fujimoto, Division of Water Quality, State Water Resources Control Board
Mr. Gerald Bowes, Division of Water Quality, State Water Resources Control Board
Ms. Kathi Moore, Office of the Director, Water Division, U.S. EPA Region IX
Mr. Eugene Bromley, CWA Standards and Permits, U.S. EPA Region IX
Ms. Elaine Chang, Deputy Executive Officer for Planning, Rule Development, and Area Sources, South Coast Air Quality Management District
Mr. David Beckman, Natural Resources Defense Council

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Dry deposition and resuspension of particle-associated metals near a freeway in Los Angeles

Lisa D. Sabin[a,*], Jeong Hee Lim[b], Maria Teresa Venezia[b], Arthur M. Winer[c], Kenneth C. Schiff[a], Keith D. Stolzenbach[b]

[a]*Southern California Coastal Water Research Project, 7171 Fenwick Lane, Westminster, CA 92683, USA*
[b]*Department of Civil and Environmental Engineering, 5237J Boelter Hall, University of California, Los Angeles, CA 90095-1593, USA*
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Received 16 February 2006; received in revised form 24 June 2006; accepted 4 July 2006

Abstract

Dry atmospheric deposition represents a potentially large source of pollutant metal contamination in urban stormwater runoff, yet there is a limited amount of research on the relationship between atmospheric emissions and water quality problems in urban areas. In Los Angeles, with air quality that ranks among the worst in the United States, significant quantities of toxic materials are released into the atmosphere every day, and paved road dust represents the largest source of particle-associated metal emissions to the atmosphere. In order to better understand the role of roadways as a source of localized metal deposition, we characterized the horizontal dry deposition patterns of chromium, copper, lead, nickel and zinc upwind and at increasing distances downwind of the I-405 Freeway in coastal Los Angeles. Dry deposition fluxes and atmospheric concentrations of these metals were highest at the site closest to the freeway, and reduced to approximately urban background concentrations between 10 and 150 m downwind of the freeway. Compared with urban background, atmospheric particle size distributions indicated the freeway was a significant source of these metals on large particles $>6\,\mu m$ in diameter, which deposit close to their source and account for the increased dry deposition flux rates observed near the freeway. The spatial pattern of measured deposition flux was well predicted by a relatively simple line-source Gaussian plume model modified to include particle deposition and resuspension. The model results indicated dilution by vertical dispersion of the plume was the most important mechanism regulating downwind concentrations and deposition.

Keywords: Atmospheric deposition; Large particles; Urban runoff; Paved road dust

1. Introduction

Dry atmospheric deposition near urban centers, especially in semi-arid regions such as Southern California, represents a potentially important non-point source of particle-associated metals to waterbodies (Baker et al., 1997; Lu et al., 2003). Atmospheric particulate matter may be directly

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deposited onto the surface of a waterbody or may reach the waterbody indirectly through deposition onto the land surface during dry periods, followed by subsequent wash-off during storm events. Atmospheric deposition may be particularly important in the Los Angeles Air Basin, since air quality in this region, with a population greater than 17 million, ranks among the worst in the United States (SCAQMD, 2000). Emission inventories of the basin indicate significant quantities of toxic materials are regularly released into the atmosphere (SCAQMD, 2003), and the ultimate fate of the heavy metals in particular is unknown.

In urban areas, emissions from paved roadways are a major source of atmospheric particulate matter (Dunbar, 1976; Cowherd et al., 1979; Reider, 1983; Cowherd and Englehart, 1984, 1985). Investigation of the most recent emission inventories for the Los Angeles region by Stolzenbach et al. (2003) found resuspended dust represents the largest source of particle-bound pollutant metals in the Los Angeles region, with paved road dust representing the most significant fraction. Paved road dust originates from pavement wear and decomposition, dustfall, litter, mud and dirt carryout, spills, biological debris, and erosion from adjacent areas (Cowherd and Englehart, 1984; Chow et al., 1990; Chow and Watson, 1992). In an urban setting, a source of zinc and copper in paved road dust is from vehicle exhaust and vehicle brake and tire wear (Watson et al., 2000; Councell et al., 2004).

Because air quality standards have been set for particles less than 10 μm in diameter due to human health concerns, most research on road dust emissions has focused on particles in this size fraction (Cowherd and Englehart, 1984; Kantamaneni et al., 1996; Venkatram and Fitz, 1998; Fitz, 2001). However, the results from a number of studies indicate nearly 50% of road dust total suspended particulate matter (TSP) emissions are due to particles larger than 10 μm (Ahuja et al., 1989; Houck et al., 1989, 1990). Moreover, particles greater than 10 μm in diameter are largely responsible for metal deposition (Lin et al., 1993, 1994; Paode et al., 1998; Zufall et al., 1998). Because coarse particles settle faster due to their greater inertia and gravitational settling, deposition of these particles is likely to occur relatively close to their source (Sehmel, 1973). Previous studies have documented a pattern of locally high atmospheric concentrations of particulate matter near roadways using tracers and downwind direct measurements of air and ground surface concentrations (Claiborn et al., 1995; Hitchins et al., 2000; Zhu et al., 2002a, b); however, few studies have focused on particle deposition gradients near roadways, especially for particles larger than 10 μm.

In addition to deposition as a source of metal loading into water bodies, re-entrainment of suspended atmospheric particles contributes to the dispersion of pollutants and impacts the subsequent mass loading into water bodies. The size of particles that can be easily resuspended ranges from 1 μm to 50 μm in diameter. Resuspended particles are estimated to travel globally; for example, Asian dust has been identified in Hawaii (Parrington et al., 1983) and Sahara dust in the central US (Perry et al., 1997). According to Sternbeck et al. (2002), measured metal concentrations in air are generally similar to the chemical profiles of crustal elements. This result indicates resuspension may control particle abundance and chemical composition.

The re-entrainment and suspension of particles in the atmosphere may occur through several natural and anthropogenic processes. Meteorological conditions during and after deposition (e.g. wind speed and intensity of rain) and surface characteristics, such as surface roughness and surface moisture, are important influences on natural resuspension (Nicholson, 1988). Anthropogenic activities such as vehicular activities, agricultural activities and various cleaning operations induce resuspension (Kashparov et al., 1994; Garger et al., 1998).

Because of the difficulty of measuring concentrations under different atmospheric stability and roadway configurations, predictions of concentration and dispersion of particulate matter near roadways have been made using line-source Gaussian plume models (Chock, 1978; Horst, 1978; Sistla et al., 1979). The most widely used versions of these models are the modified HIWAY (Zimmerman and Thompson, 1975), HIWAY-2 (Peterson, 1980), GM (Chock, 1978), and CALINE-3 (Benson, 1979). However, these models have primarily been used to estimate vapor phase concentrations of constituents such as carbon monoxide, and do not include deposition or resuspension.

This study was designed to gain a better understanding of the role of major roadways, such as a freeway, as a significant source of localized metal deposition to urban surfaces, and to understand the role of resuspension in the net deposition and dispersion of particulate matter near roadways. To accomplish this goal, the following objectives were

defined: (1) to characterize the horizontal dry deposition gradient and atmospheric concentrations of five pollutant metals (chromium, copper, lead, nickel and zinc) near a major freeway in Los Angeles; (2) to compare atmospheric particle size distributions of these metals near a freeway with urban background values; and (3) to compare measured horizontal deposition fluxes with the predictions of a Gaussian line-source dispersion model modified to include deposition and resuspension.

2. Methods

2.1. Field sampling

2.1.1. Site description

The freeway site selected for this study was the I-405 freeway between Wilshire and Sunset Boulevards in West Los Angeles (Fig. 1). This site provided appropriate conditions to study the impact of the freeway on localized deposition for two reasons. First, this stretch of freeway runs in a north-west to south-east direction, and is approximately perpendicular to the on-shore, southwest winds which are typically dominant in coastal Los Angeles during daytime in the spring. Second, the I-405 freeway has a heavy traffic volume, with an annual average daily traffic count of approximately 300,000 (California Department of Transportation and (CA DOT), 2004). All sampling equipment was located along Constitution Blvd, which runs perpendicular to the freeway. This site has been used successfully by previous researchers documenting air pollutant concentration gradients with distance from the freeway (Zhu et al., 2002b).

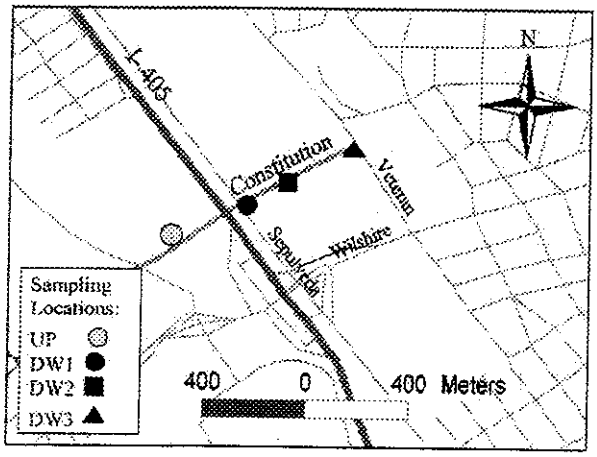

Fig. 1. Map of the freeway site and sampling locations.

Dry deposition flux of metals was measured simultaneously at three sites located at 10 (DW1), 150 (DW2) and 450 m (DW3) downwind, and one site approximately 150 m upwind (UP) of the I-405 Freeway over a three-week period in April and May, 2003. All deposition measurements were collected during daytime, high traffic hours (e.g. from approximately 8 AM to 5 PM) over a period of three to four days for a single sample, in order to obtain sufficient mass. Simultaneously with the dry deposition flux measurements, atmospheric concentrations of TSP were collected at two downwind sites (DW1 and DW3) and analyzed for both particle mass and metal concentrations. Atmospheric concentrations of metals on four coarse particle size fractions were also measured at the downwind site closest to the freeway (DW1) one day each week. All sampling took place during typical meteorological conditions for spring in Los Angeles, during periods with no precipitation. Local wind data were utilized during sampling to confirm the upwind and downwind status of the sampling locations.

2.1.2. Instrumentation

Dry deposition flux measurements were made using a 33 cm diameter circular polyvinyl chloride (PCV) plate with a sharp edge ($<10^{\circ}$ angle), covered with a Mylar® sheet coated with Apiezon L grease. The grease was liquefied by heating and then painted onto the Mylar film to obtain a thin, uniform 10 μm layer. This surrogate surface has been used previously and is described in more detail elsewhere (Lim et al., 2006). During sampling, the plate was mounted onto a tripod at a height of 2 m. A filter-based sampling system attached to a vacuum pump was used to collect TSP for measurement of atmospheric concentrations of metals. The open-faced inlet was loaded with a 37 mm, 2.0 μm pore Teflon® filter (Pall Life Science), and sampling was done at a flow rate of 10 L min^{-1}. Meteorological data, including wind speed and direction, temperature, relative humidity and barometric pressure, were also measured during each sampling period using a portable meteorological station (PortLog, Rain Wise, Inc.) located at the DW2 site.

A Noll Rotary Impactor (NRI) was used to collect size distributions of particulate matter on different coarse particle fractions for measurement

of atmospheric concentrations of metals. This instrument has been used successfully to measure air concentrations on coarse particle size fractions in other studies (Mamane and Noll, 1985; Noll et al., 1985; Lin et al., 1994). The NRI operates by simultaneously rotating four rectangular collector stages through the air at high velocity to collect particles directly from ambient air by impaction. Each collector stage is a different width to collect a different particle size fraction. The collector stages were mounted with Mylar strips, sized according to the size of the collector stage, which were coated with Apiezon L grease in the same manner as the Mylar for the deposition plates. The instrument was operated at 320 rpm, producing cut diameters of 6, 11, 20 and 29 μm for the four collector stages. To prevent overloading, the smallest collector stage (stage A) was changed every 2 h, while the next largest collector stage (stage B) was changed every 4 h. The two largest collector stages (stages C and D) were not changed during the ~8-h collection period. The metal concentration on the particle size fraction smaller than 6 μm was obtained by subtracting the metal mass concentration collected on the NRI Stage with the cut diameter of 6 μm from the TSP metal mass concentration.

2.1.3. Sample handling and chemical analysis

Prior to sampling, Mylar was cut to the desired size (33 cm diameter circles for the deposition plates and rectangular strips sized for the desired cut points of the NRI) and cleaned by wiping with methanol-soaked wipes, then immersed in 10% nitric acid followed by methanol for five minutes each. After cleaning, the Mylar pieces were rinsed with distilled water and allowed to air dry. Dry Mylar strips and circles were coated with a thin layer of Apiezon L grease and mounted onto the collector stages of the NRI and the deposition plates, respectively, one day prior to sampling. Both the NRI stages and the deposition plates were stored in airtight containers for transport to the field.

After sampling, the Mylar strips were removed from the NRI stages and each strip stored in a clean Petri dish. The Mylar circles were removed from the deposition plates, folded (greased side inward), and placed inside a clean glass jar. In the lab, Mylar circles were divided into 10 smaller pieces, and the 10 pieces returned to the original sample jars. The Mylar strips were placed into clean 15 mL plastic centrifuge tubes. The Mylar circles and strips were rinsed three successive times with 15 mL of *n*-hexane. The rinses were combined into a 50 mL centrifuge tube. The Mylar pieces were then rinsed with 5% Optima Grade nitric acid and the acid rinses were added to the combined hexane rinses. The hexane was evaporated in a 50 °C water bath and the remaining acidified sample was then heated to 65 °C under sonication for a minimum of 24 h.

For the TSP instrument, a clean Teflon filter was weighed after equilibrating for 24 h in a room with approximately constant temperature and humidity conditions. After weighing, the filter was loaded into the sample holder, and the sample holder stored in a clean, airtight plastic bag for transport to the field. After sampling, the filter was removed from the holder and placed in a clean petri dish and transported to the lab. Prior to analysis, the filters were again weighed. The filters were transferred into clean 15 mL plastic centrifuge tubes, and 10 mL of 5% Optima Grade nitric acid were added and the tubes capped tightly. The acidified samples were then heated to 65 °C under sonication for a minimum of 24 h.

All acid-digested samples were transferred to a centrifuge tube and analyzed for 26 metals per EPA Method 200.8 using inductively coupled plasma-mass spectroscopy (ICP-MS). Results reported here are for chromium, copper, lead, nickel and zinc, because these are the primary metals associated with water quality issues in Southern California. Method detection limits were 0.5 ng for lead and 1 ng for all other metals, corresponding to a minimum detectable air concentration of 0.02 ng m^{-3} and a minimum detectable deposition flux of 0.004 μg m^{-2} day^{-1} for lead and 0.01 μg m^{-2} day^{-1} for all other metals. Laboratory blanks were analyzed with each batch of 15 samples. In addition to samples, field blanks (greased Mylar sheets mounted onto a duplicate deposition plate, Teflon filters loaded into a TSP sampling cartridge) were prepared, taken to the field during a sampling event, and analyzed along with the samples collected at the site. All laboratory blanks were non-detects; however all field blanks contained detectable levels of metals, and all samples were corrected for their respective field blank.

Field duplicates indicated the precision of the deposition plates. For each metal, the relative percent difference (RPD) between duplicate deposition plates, on average, was 31% (chromium), 25% (copper), 87% (nickel), 24% (lead), and 47% (zinc). This was an acceptable level of precision for field duplicates because differences of less than a factor of two

between fluxes measured during different sampling events were typically not considered significant.

2.1.4. Image analysis of NRI Mylar strips

An image processing program was used to count particles and to obtain the particle size and mass distributions of the particles deposited on the NRI stage A ($d_p > 6.6$m) from photographs of the Mylar strips taken with an optical microscope (LW Scientific) set at a magnification of 100×. For each image the distribution of the aerodynamic particle diameter d_p was determined using

$$d_p = \frac{1}{\tilde{S}_v}\left(\frac{\rho_p}{\rho_0 S_D}\right)^{1/2} d_{PA}, \quad (1)$$

where d_{PA} is the equivalent projected area diameter measured by the image analysis, S_D is a dynamic shape factor set equal to 1.41 (Davies, 1979), ρ_p is the particle density assumed to be 1800 kg m^{-3}, ρ_0 is a unit particle density of 1000 kg m^{-3}, and $\tilde{S}_v$ is the volume averaged shape factor set equal to 1.61 for urban sites (Lin et al., 1994; Tai et al., 1999). The aerodynamic diameter (d_p) and assumed particle density (ρ_p) are then used to calculate total particle volume and mass. The atmospheric concentration is obtained using the known NRI rotation speed and empirically determined collection efficiencies (Noll et al., 1985).

2.2. Modeling approach

The model used in this study was based on the ground-level line-source Gaussian plume model, formulated to consider metal deposition and resuspension (Horst, 1978). Assumptions for the model were constant emission rate, constant wind speed both in time and space, neutral stability (stability D), and a flat and unobstructed ground surface (Masters, 1998). The emissions from the freeway were assumed to form a single, continuously emitting, infinite line source with metal mass flow per unit length q_0 (mg m^{-1} s).

With these assumptions, the metal concentration in the air down wind at distance x and elevation z from the line source can be described by the following:

$$C(x,z) = \frac{1}{u\sqrt{\pi/2}}\left\{\frac{q_0}{\sigma_z(x)}\exp\left(\frac{-z^2}{2\sigma_z^2(x)}\right) + \int_0^x \frac{m(x)}{\sigma_z(x-\xi)}\exp\left(\frac{-z^2}{2\sigma_z^2(x-\xi)}\right)d\xi\right\}, \quad (2)$$

where u is the wind speed; $m(x)$ = net metal mass flow per unit ground surface area (mg m^{-2} s^{-1}) at a distance x resulting from deposition and resuspension; $\sigma_z(x) = c(x)^d + f$ = vertical standard deviation of the plume at a distance x from the plume source, where c, d, and f are constants that are a function of the stability classification (Masters, 1998).

The net metal mass flow to the atmosphere per unit ground surface area resulting from deposition and resuspension is computed by

$$m(x) = \Lambda G(x) - V_d C(x,0), \quad (3)$$

where $G(x)$ (mg m^{-2}) is the surface metal mass per unit area, Λ (s^{-1}) is a specified resuspension rate, $C(x, 0)$ is the ground level metal concentration in the air, and V_d is a specified deposition velocity. The change in surface contamination with time is then given by

$$\frac{dG(x)}{dt} = -m(x) = V_d C(x,0) - \Lambda G(x), \quad G(x) = 0 \quad \text{at } t = 0. \quad (4)$$

The build-up of $G(x)$ is the only time dependent process in the model, although changes in $G(x)$ drive changes in all other variables. A steady-state condition where $m(x) = 0$ and $\Lambda G(x) \approx V_d C(x,0)$ is reached in a time of about $1/\Lambda$. The steady-state atmospheric metal concentration is given by the first term in Eq. (2) and is independent of the deposition velocity V_d. and the resuspension rate Λ, but the deposition flux is $V_d C(x,0)$.

3. Results and discussion

3.1. Meteorological data

There was little day-to-day variability in the meteorological data measured during the sampling at the freeway site (Table 1), and even hour-to-hour variability during the 8 AM–5 PM sampling period within the same day was low. Because meteorological conditions were stable throughout the study period, we did not attempt to correlate these data with our weekly concentration or deposition flux measurements. Wind direction remained predominately from the southwest on all sampling days, as expected for springtime in Los Angeles, maintaining the desired upwind and downwind locations of our sampling sites.

Table 1
Summary of mean meteorological data measured during sampling at the freeway site

Week	Date	Temperature (°C)	Relative humidity (%)	Wind speed ($m s^{-1}$)		Wind direction from:
				Mean 8-h	Range of 10-min Max	
1	13-April-04	19±1	63±4	2.1±0.6	0.4–7.2	Southwest
	14-April-04	19±1	62±4	2.1±0.7	2.2–7.2	Southwest
	15-April-04	20±1	62±2	2.1±0.7	2.7–6.7	Southwest
	16-April-04	18±1	61±5	2.1±0.6	3.1–6.7	Southwest
2	19-April-04	18±1	54±4	2.4±0.8	2.7–8.0	Southwest
	20-April-04	19±1	60±5	2.4±0.7	2.7–7.2	Southwest
	21-April-04	19±1	64±3	2.4±0.6	3.1–7.2	Southwest
3	28-April-04	21±2	67±7	2.2±0.5	2.7–7.2	Southwest
	29-April-04	20±1	55±4	2.4±0.5	3.1–7.2	Southwest
	30-April-04	19±1	67±5	2.7±0.6	3.1–7.2	Southwest
	1-May-04	26±1	38±5	2.5±0.4	4.0–6.3	Southwest

Ten-minute data were recorded. The 8-h means are presented here, except as noted.

Table 2
Mean dry deposition flux ± standard deviation ($\mu g m^{-2} day^{-1}$) of metals measured at varying distances from the I-405 Freeway

Location	Chromium	Copper	Nickel	Lead	Zinc
10 m Downwind (DW1)	4.3±0.3	48±8	3.1±0.6	24±3	144±33
150 m Downwind (DW2)	2.4±1.9	18±7	1.0±1.3	11±4	45±23
450 m Downwind (DW3)	2.5±1.1	14±3	1.2±1.1	7.3±1.8	38±1
150 m Upwind (UP)	2.2±0.5	11±5	1.5±0.9	7.9±1.3	37±10

$N = 3$ for all metals.

3.2. Dry deposition flux gradient near freeway

The highest measured deposition fluxes of metals were observed at the downwind site closest to the freeway (DW1) for all five metals, although the largest differences were observed for copper, lead and zinc (Table 2). For copper, lead and zinc, ANOVA indicated the difference between sites was significant ($p < 0.002$). This difference was due entirely to the higher fluxes observed at the DW1 site, based on the Tukey test for pairwise multiple comparisons ($p < 0.003$). Mean fluxes at DW1 were higher than UP and DW3 by factors of two to five, depending on the metal. Mean fluxes at DW1 were higher than DW2 by factors of two to three for all five metals. In contrast, for all five metals, differences in fluxes measured at the UP site (considered to represent "urban background"), DW2, and DW3 sites were not significant (ANOVA, $p > 0.05$).

These results indicated dry deposition fluxes of metals were higher at short distances from the freeway, and quickly reduced to urban background fluxes within 150 m, especially for copper, lead and zinc. These results were similar to the observations of Zhu et al. (2002b) for ultra fine particle concentrations ($d_p < 0.1\,\mu m$) measured downwind of the same freeway in which high concentrations near the freeway reduced to urban background within 300 m. The small sample size in this study was an important limitation of these data. However, the general trend of decreasing deposition flux with distance from the freeway was consistently observed during the study period. These results also suggested sources of deposited copper, lead and zinc may be different from chromium and nickel. The fluxes of copper, lead and zinc observed to be significantly higher close to the freeway suggest (1) the freeway acts as a significant source of these metals and (2) these metals had substantial concentrations on larger particles, which are expected to deposit close to their source. The freeway likely represents a source of large particles containing copper, lead and zinc because of resuspension of road dust as vehicles travel on the freeway at high velocities (Sehmel, 1973; Nicholson et al., 1989), and from tire and

brake wear from vehicles (Chow et al., 1990; Chow and Watson, 1992; Councell et al., 2004).

3.3. Atmospheric concentrations near the freeway

TSP metal concentrations were higher at the downwind site closest to the freeway (Fig. 2a), although the differences between DW1 and DW3 were only significant for lead and zinc using the paired samples t-test ($p < 0.02$). TSP particle mass concentrations were also consistently higher at the downwind site closest to the freeway (DW1) compared with the furthest site (DW3) (Fig. 2b), however differences between the sites were not statistically significant. Again, the sample size ($n = 3$) may have limited our ability to detect small differences between locations.

3.4. Relative distribution of metals on different particle size fractions

The relative distribution of metal mass among particle size fractions, as determined from the NRI and TSP metal concentration data, was different near the freeway from distributions observed at urban background locations. Fig. 3 shows the mean percent contribution to five particle size fractions (< 6, 6–11, 11–20, 20–29, and >29 μm) for each metal measured near the freeway, and compared with the mean distribution measured at urban background sites in Los Angeles located away from major freeways using the same instrumentation (Lim et al., 2006). The primary difference between the freeway site and the urban background sites was that more metal mass fraction was observed in the particle fraction >6 μm at the freeway site, especially for copper, lead, and zinc, while at the urban background sites, the majority of the mass fraction (approximately 75%) for all metals was observed in the particle size fraction <6 μm.

One limitation of this study is that we did not have simultaneous measurements of the particle size distribution near the freeway and at urban background. However, as we observed both lower TSP metal concentrations at the DW3 site, and reduced metal mass fraction due to the largest particles at urban background locations away from the freeway, we hypothesize the lower metal concentrations were due to removal of the largest particles by deposition near their source. Thus, we conclude differences in the particle size distributions of metal mass at the freeway site compared with urban background sites likely

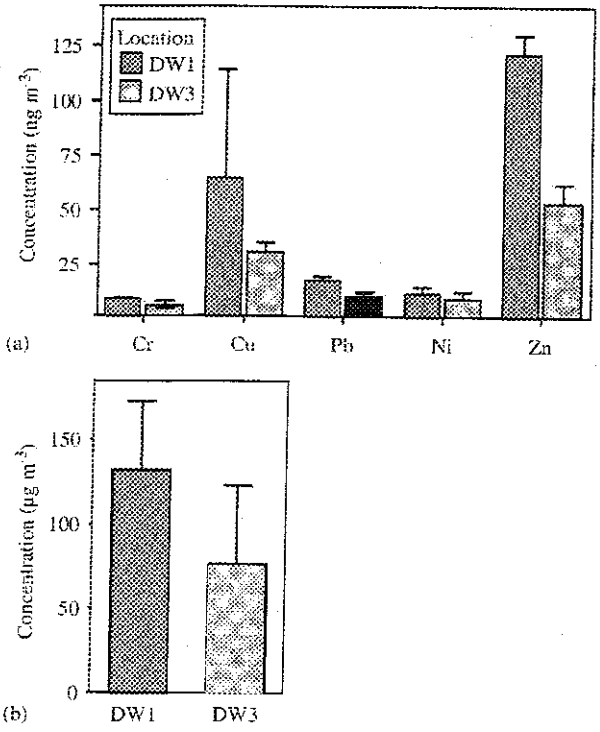

Fig. 2. Mean atmospheric TSP concentrations downwind from the I-405 Freeway of (a) metals and (b) particulate matter mass. DW1 = 10 m downwind: DW3 = 450 m downwind. Error bars represent the standard deviation for the mean.

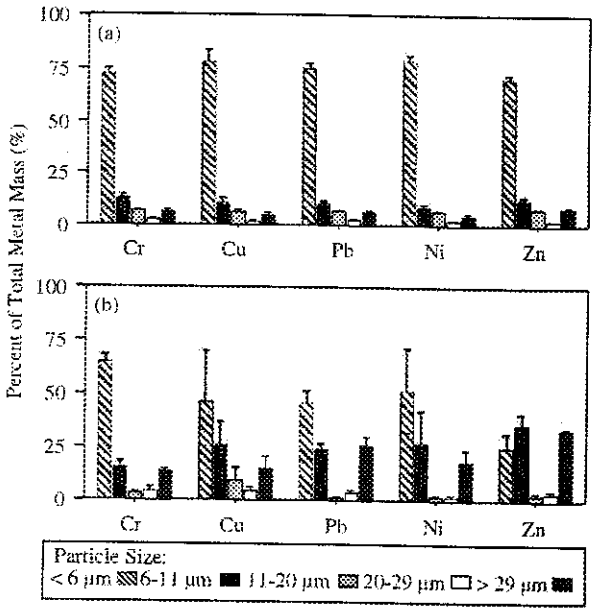

Fig. 3. Mean distributions of metal concentrations on five particle size fractions as a percent of the total metal mass measured (a) at urban background sites as measured by Lim et al. (2006) and (b) 10 m downwind of the I-405 Freeway. Error bars are the standard error of the mean.

resulted from the freeway acting as an emission source for particles >6 μm. These coarse particles are more readily removed from the air by deposition close to the source, and thus we expect to find them at lower concentrations, and as a lower percentage of the total mass, as distance from the emission source increases. Smaller particles (<6 μm), which are slow to deposit, remain suspended and contributed a higher proportion of the total mass away from local sources. This explains why both atmospheric concentrations of metals on the largest particles and metal deposition fluxes were reduced at sites further removed from a freeway. Corroborating results from our deposition plate data indicated the majority of this removal occurred very near to the source (e.g., between 10 and 150 m), and resulted in deposition fluxes and concentrations downwind of the freeway comparable to urban background at some distance greater than 10 m, and within 150 m.

3.5. Image analysis results

Size-segregated hourly variation of particulate mass concentration for particles greater than 6 μm in diameter was estimated using image analysis of the stage A NRI strips. A comparison of the particulate mass concentration at an urban background site (as measured by Lim et al., 2006) and the freeway transect is shown in Fig. 4. The particle mass observed in the fraction >29 μm at the freeway site was relatively constant over time, while this size fraction was absent during the morning period, 7:00–11:00 AM, at the urban background site, which had higher particulate matter concentrations only later in the day, probably as a cumulative result of resuspension from traffic. The total particle mass concentration associated with particles >6 μm at the freeway site ranged from 23–31 $\mu g\,m^{-3}$, compared with 10–16 $\mu g\,m^{-3}$ at the urban background site. The higher particle mass concentration at the freeway site most likely reflected the close proximity to the freeway. Using ANOVA ($p>0.5$), the time variation of the total particulate mass concentration at the freeway site for particles >6 μm did not show any significant difference between times, likely because of the relatively constant traffic flow on this particular freeway.

3.6. Modeling results

Model calculations used a wind speed $u = 2\,m\,s^{-1}$, which was the average value during the observation period, and a deposition velocity $V_d = 0.01\,m\,s^{-1}$, which was the mean of the flux-averaged deposition velocities calculated for each metal by dividing the measured deposition flux by the air concentration measured by the TSP sampler at both the DW1 and DW3 locations (Table 3). Resuspension rates Λ reported in the literature for surfaces of all types vary from 10^{-13} to $10^{-6}\,s^{-1}$ (Nicholson, 1988), and for asphalt surfaces from 5×10^{-9} to $6\times10^{-8}\,s^{-1}$ (Sehmel, 1980). For the present study, values of Λ between 10^{-9} and $10^{-6}\,s^{-1}$ reflect the possible range of surface conditions, corresponding to a time to steady-state ranging from 10 to 10,000 days and indicating the surface metal concentration reflects an accumulated average of time-varying conditions. For this reason, the deposition flux measurements were compared with the deposition flux predicted by the steady-state model solution. Because the steady-state atmospheric concentration distribution reflects a balance between deposition and resuspension, the calculated atmospheric concentration and deposition flux are independent of the assumed resuspension rate. Calculations with $\Lambda = 0$, i.e. no resuspension but net loss by deposition, provided an upper bound on the effect of losses by deposition on the atmospheric concentration and associated deposition flux.

Steady-state model predictions of downwind deposition patterns were compared with observed values of normalized "excess" deposition, calculated by subtracting the calculated and measured deposition rates at the upwind site, which are zero in the model, from the calculated and measured values at the downwind sites and dividing the difference by the excess value calculated and observed at the closest downwind site. This normalization, which was necessary because the line source emission rate q_o was unknown, removes any effect of the absolute magnitude of deposition and focuses on the downwind spatial variation of deposition.

Good agreement between the steady-state model calculation and measured deposition fluxes was obtained for chromium, copper, lead, and zinc, particularly within 200 m from the source (Fig. 5). The data for nickel diverged from the model results, which was not surprising because of the expected absence of a nickel source at the freeway. Both the model and the measurement data indicated deposition and air concentrations return to background between 100 and 150 m from the source; a result consistent with the findings of Zhu et al. (2002b) for

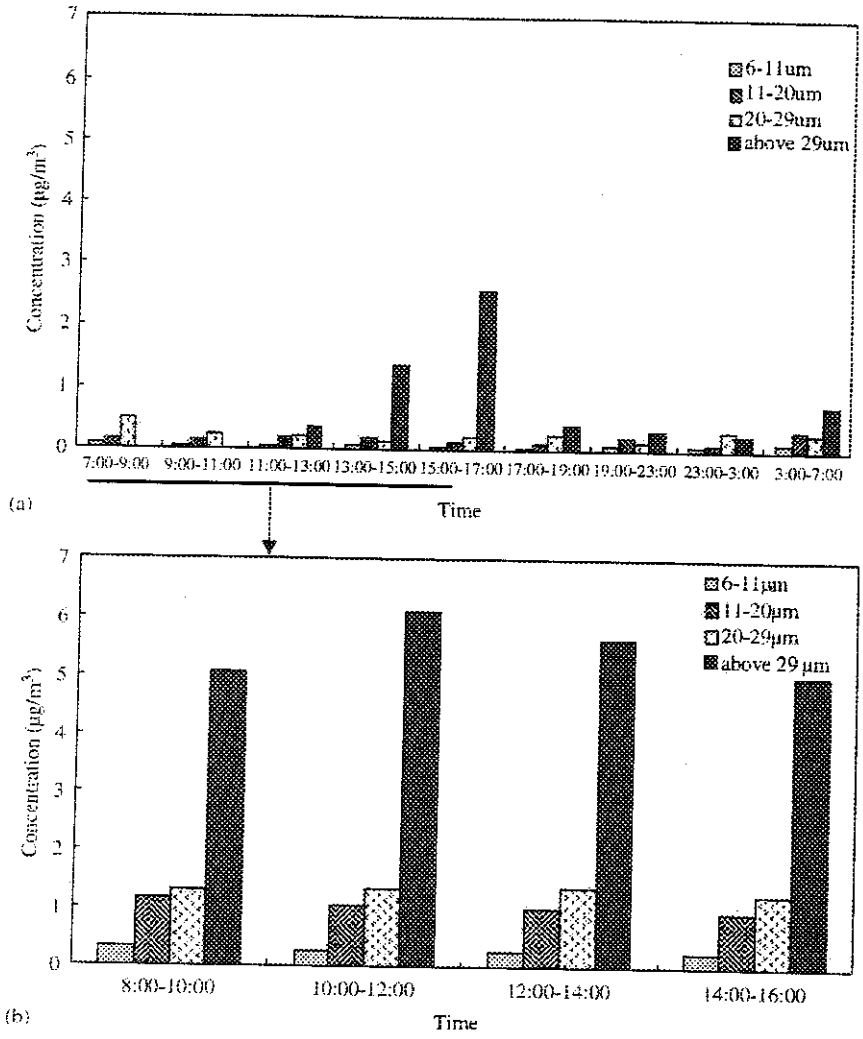

Fig. 4. Diurnal pattern of particulate mass concentration measured using image analysis: (a) urban background site as measured by Lim et al.. (2006); (b) freeway site (this study).

Table 3
Measured flux-averaged deposition velocities for different metals

Metal	N	Deposition velocity ($cm\,s^{-1}$)
Chromium	6	0.56 ± 0.1
Copper	6	1.4 ± 2
Lead	6	1.3 ± 0.5
Nickel	6	0.26 ± 0.2
Zinc	6	1.1 ± 0.4

ultra fine particles. Model calculations with $\Lambda = 0$ were nearly identical to the steady-state solution, indicating that on the scale of this experiment

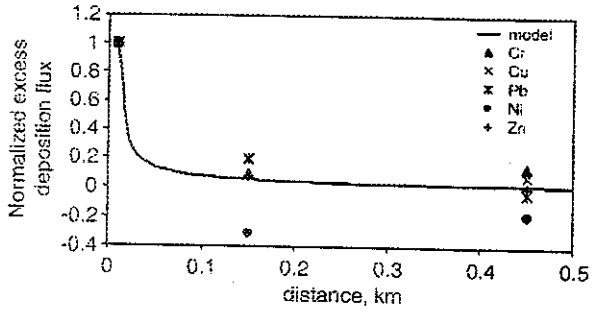

Fig. 5. Comparison of computed and measured normalized excess deposition flux (see text for definition). The solid line is the steady-state model prediction using a wind speed $u = 2\,m\,s^{-1}$ and a deposition velocity $V_d = 0.01\,m\,s^{-1}$.

atmospheric dispersion is the major mechanism determining the spatial distribution of atmospheric metal concentration and metal deposition flux.

4. Conclusions

Our findings indicated metal deposition was increased in the immediate vicinity of a large freeway, and quickly reduced to urban background deposition rates between 10 and 150 m downwind of the freeway, especially for copper, lead and zinc. Furthermore, higher concentrations at the downwind site closest to the freeway were primarily due to increased mass in the particle size fraction $>6\,\mu m$ because the freeway acts as an emission source for particles $>6\,\mu m$, which are removed from the air by deposition close to the source. Because of resuspension, particles $>6\,\mu m$ are consistently observed at urban background locations, but as a smaller percentage of the total mass as distance from the emission source increases. These results suggest (1) the freeway acts as a significant source of copper, lead and zinc and (2) these metals have substantial concentrations on larger particles emitted from the freeway due to the dispersion of road dust by vehicles traveling at high speeds. Furthermore, the modified Gaussian plume model showed relatively good agreement with deposition measurements, dispersion being the most significant process controlling the spatial variation of concentration and deposition.

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Mercury concentrations in coastal California precipitation: Evidence of local and trans-Pacific fluxes of mercury to North America

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Abstract

Because of mercury's (Hg) relatively high vapor pressure and long (0.5–2 years) atmospheric residence, there is the potential for long-range transport of contaminant Hg. Many studies have focused on that transport and deposition in central and eastern North America, Europe, and the Arctic, but there has been little research on the cycling of Hg in the western coast of North America. That deficiency is addressed in this preliminary study, which indicates there is long-range transport of Hg across the North Pacific. This transport is evidenced by the elevated (relative to equatorial and theoretical baseline) Hg concentrations in rainwater collected on the coast of California, as well as by the positive correlation between North Pacific storm tracks and Hg concentrations, with maximum concentrations associated with storms from 20°–40° latitude. Those tracks trace air masses containing industrial emissions with peak O_3 concentrations moving eastward off the Asian continent. The Asian fluxes appear to enhance Hg concentrations both directly, through the emission of particle-bound Hg and reactive Hg^{2+}, and indirectly, by increasing the rate of oxidation of Hg^0 in the atmosphere. Superimposed on the trans-Pacific background of industrial Hg is a local signal, with elevated concentrations at the urban site relative to the more pristine coastal site in California. This secondary enrichment is tentatively attributed to elevated local emissions of redox species, including O_3 and its precursors, which increase oxidation rates of Hg^0 in the atmosphere and Hg concentrations in precipitation.

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